PROSPECTIVE OBSERVATIONAL STUDY TO EVALUATE THE ROLE OF MRI IN DIAGNOSIS AND MANAGEMENT OF PELVIC FLOOR DYSFUNCTIONS

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BONAFIDE CERTIFICATE

This is to certify that the dissertation entitled **"PROSPECTIVE OBSERVATIONAL STUDY TO EVALUATE THE ROLE OF MRI IN DIAGNOSIS AND MANAGEMENT OF PELVIC FLOOR DYSFUNCTIONS"** is the bonafide original work of Dr.Poornima Shankar under the guidance of Dr.T.K.Shaanthy Gunasingh MD.,DGO., Professor and Head of the department of Obstetrics and Gynaecology KMCH,Chennai in partial fulfilment of the requirements for MS Obstetrics and Gynaecology branch II examination of the Tamilnadu Dr.MGR Medical university to be held in April 2015 .The period of Postgraduate study and training from June 2012 to April 2015.

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DECLARATION

I solemnly declare that this dissertation **"PROSPECTIVE OBSERVATIONAL STUDY TO EVALUATE THE ROLE OF MRI IN DIAGNOSIS AND MANAGEMENT OF PELVIC FLOOR DYSFUNCTIONS"** was prepared by me at Government Kilpauk Medical College and hospital,Chennai, under the guidance of **Dr.T.K Shaanthy Gunasingh,M.D.,D.G.O.,**Professor and Head of the Department,Department of Obstetrics and Gynaecology,Government Kilpauk Medical College and hospital,Chennai.

This dissertation is submitted to **The Tamil Nadu Dr.M.G.R. Medical University,Chennai** in partial fulfillment of the University regulations for the award of the degree of **M.S Obstetrics and Gynaecology.**

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Date: (Dr.Poornima Shankar)

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INTRODUCTION

On an average,about 30-50% of women develop pelvic organ prolapse in their lifetime[1]. It is a common condition which can cause significant impact on the quality of life. The prevalence appears to increase with increasing life expectancy. Many of these people require surgery and almost 30% of them require repeat surgery[2].This indicates that the current diagnostic modalities and surgical management is far from satisfactory.Hence the need for a promising tool for

Pre- treatment evaluation for patients with pelvic floor dysfunctions.

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Imaging is mainly useful in persons in whom the physical clinical examination findings are inconclusive or equivocal. Jennifer Hubert et al in 2008

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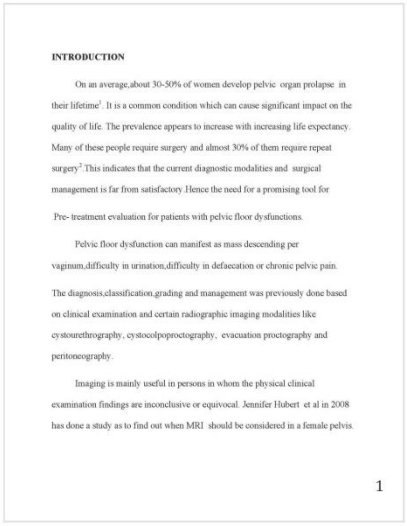

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Pelvic floor dysfunction can manifest as mass descending per vaginum,difficulty in urination,difficulty in defaecation or chronic pelvic pain. The diagnosis,classification,grading and management was previously done based on clinical examination and certain radiographic imaging modalities like cystourethrography, cystocelpoproctography, evacuation proctography and peritoneography.

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CONTENTS

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Yan Mee Law and Julia R. Fielding et al in 2008 have made a review on the anatomy and various causes of pelvic floor weaknesses in women and also role of MRI in pelvic floor dysfunctions. A few other studies have also been attempted world wide to evaluate the role for newer dynamic modalities in the diagnosis and pre treatment planning of pelvic floor dysfunctions.

The need of the hour is a non invasive modality that helps in better understanding of the complex anatomic changes for better management i.e for the improvement of symptoms as well as to prevent recurrence and the role of the conservative management –to know how better the anatomic changes improve.Hence this study was intended to know the anatomical changes in various types of pelvic floor dysfunctions and the role of conservative management(pelvic floor excercises) in various dysfunctions-using dynamic MRI of the pelvic floor.

Pelvic organ prolapse is downward displacement of the structures that are normally situated at the level of or near the vaginal vault. Since these displacements are often due to defects in integrated connective tissue , they may each be considered as pelvic hernia. They are common

and they affect a significantly larger percentage of women as their age increases. Whereas mortality from this condition is negligible, significant morbidity and deterioration of lifestyle may be associated with pelvic floor dysfunctions.

The impact that these conditions have on urinary, sexual functions and gastrointestinal functions can only be felt by those females who are burdened with pelvic floor dysfunctions on a daily basis. The management of pelvic floor dysfunctions and the associated symptoms poses a major challenge to gynaecologists. More specifically in the advanced state, management of these conditions is one of the most challenging problems a pelvic surgeon can face.

Providing permanent relief by restoring the normal anatomy and maximum possible physiologic functions always tests the ingenuity of gynecologists. But for the best and one time cure with least recurrence a proper pre- treatment evaluation to study the anatomical changes and the defects in the pelvic floor is necessary. A combination of anatomic, physiologic and biomechanical principles is needed for the treatment.

REVIEW OF LITERATURE

HISTORY

Genital Prolapse is atleast as old as Egyptian mummy.Prolapse simply means downward descent.while from physicist view, its root cause would be incessant pull of gravity, from gynaecologist view , it would be failure of normal structural ,functional and bio mechanical antigravity mechanism or operation of some progravity mechanism.

Prolapse is a disease known from ancient times, mentioned in notes of Hippocrates and galen. Tampons, massages, exercises and vaginal packing were treatments use in olden days with some success. Unscientific modes of treatment like silver nitrate, nitric acid, acid nitrate of mercury, hot metal, sulfuric acid even suspension from feet for 24 hours have all been practised till recent past. Recent advances in imaging studies like endovaginal and endoanal ultrasound , MR imaging including dynamic MRI have revolutionised the understanding the disease, and also in planning the surgeries especially site specific repairs.

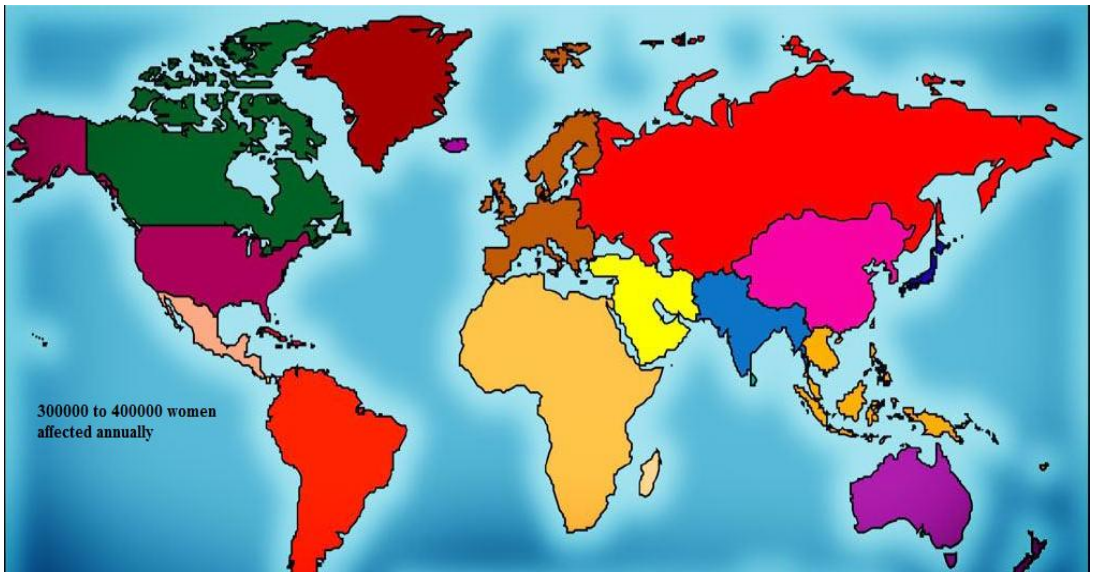
INCIDENCE

Pelvic floor dysfunction affects 300000 to 400000 persons annually worldwide[1].Overall about 37% of women show one or more pelvic floor dysfunctions.Anal incontinence is the involuntary discharge

of faeces or flatus, had a prevalence of 25%.This was followed by stress urinary incontinence(SUI), overactive bladder, and pelvic organ prolapse.About 80% of women having one dysfunction were also found to have one or more pelvic floor dysfunctions coexisting.

Coexistence of two or more pelvic floor dysfunctions had the following incidence:

- In 80% of patients with SUI or overactive bladder.
- In 70% of patients with pelvic organ prolapse.
- In 50% of patients with anal incontinence.[3]

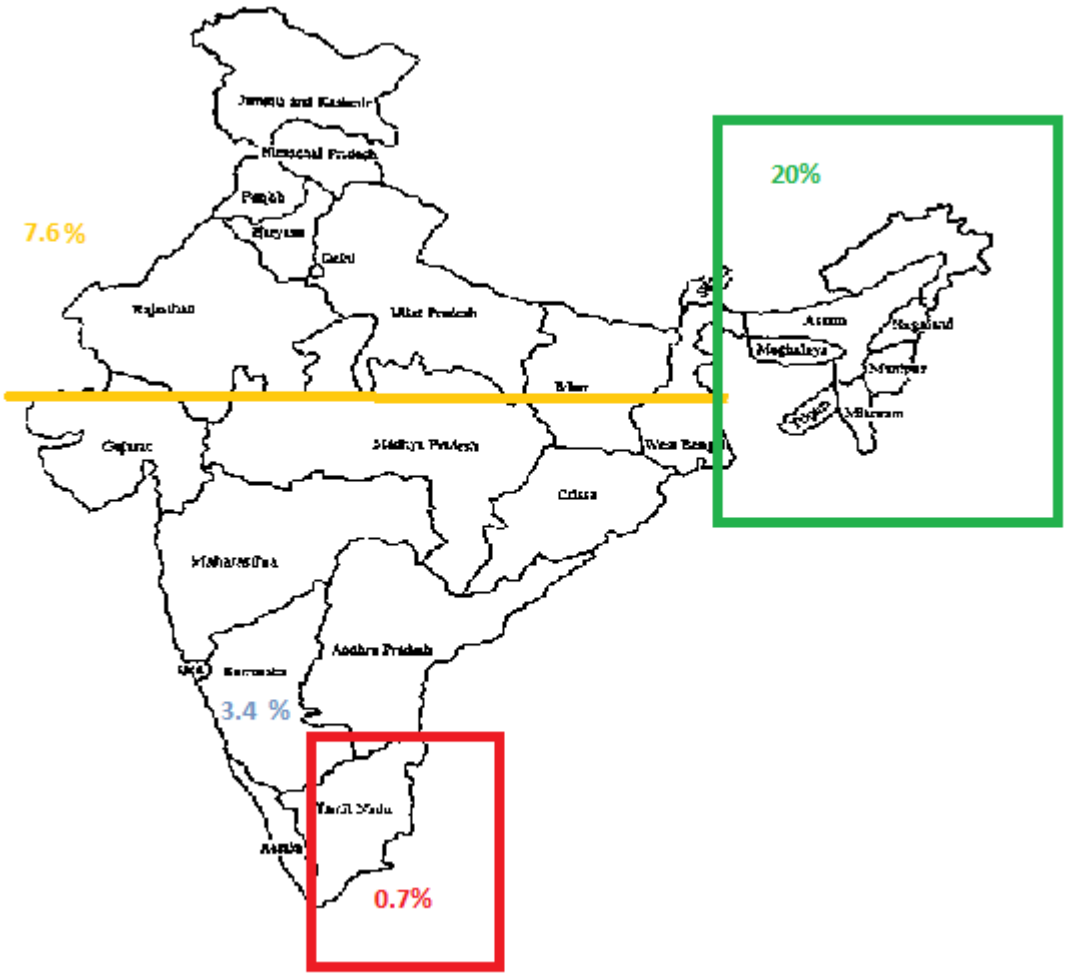


Internationally, the hospital admission for uterine prolapse is 20.4%,percentage of whom surgery for prolapse is done is 16.2%.[4] The average incidence of prolapse uterus in the United states is about 11.4%,

in Italy 5.5%,in Egypt 56%, California 1.9%, Pakistan 19.1%, Iran 53.6%. It has been calculated that about 60,000 women from Nepal are having uterine prolapse and of them 18600 are in the need of surgical intervention.[5]

INCIDENCE OF UTERINE PROLAPSE IN INDIA

It has been estimated that among women coming to private hospitals in northern and western parts of India with gynecological problems one out of five are having uterine prolapse. The incidence of uterine prolapse in North India is 7.6%.The incidence in Eastern India is estimated to be around 20%. In South India mainly in the state of Tamilnadu, the incidence of uterine prolapse is estimated to be 0.7% and in the state of Karnataka the incidence of uterine prolapse is 3.4%.[5]



PELVIC FLOOR ANATOMY

The position, suspension, and support of the uterus, vagina, bladder, and rectum depend on an interdependent system. This three dimensional system consists of bony, muscular, and connective tissue. Even meagre alterations in any one part can cause stresses in other parts that gradually lead to failure of normal anatomy. Therefore a thorough knowledge of normal applied pelvic anatomy is a must in the repair of pelvic organ dysfunctions.

The pelvic organs are supported in the upright position by the pelvic floor,a fibromuscular floor which mainly includes the pelvic diaphragm.It includes levator ani muscle covered by pelvic fascia.

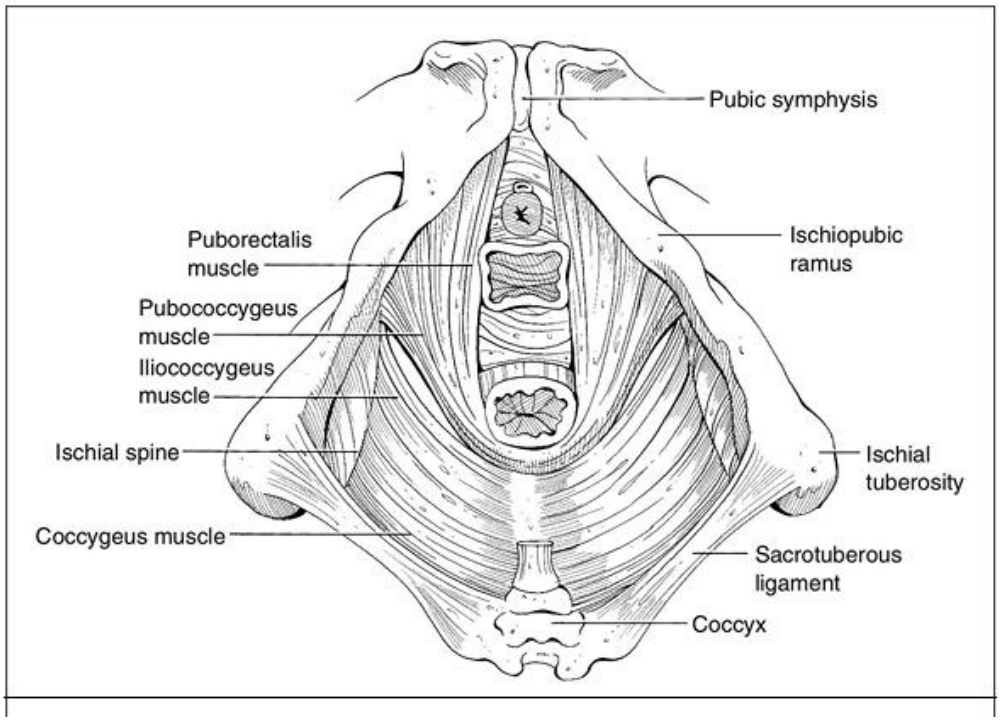
The Pelvic Floor

The opening in the bony pelvis lies at the bottom of the abdominopelvic cavity.There is a supportive system evolved to prevent the pelvic organs from being pushed downward through this opening. A multitude of visceral ligaments and fasciae supports the organs and maintain their position over the closed portions of the floor. The floor consists of the levator ani muscles and perineal membrane.

Levator Ani and Pelvic diaphragm

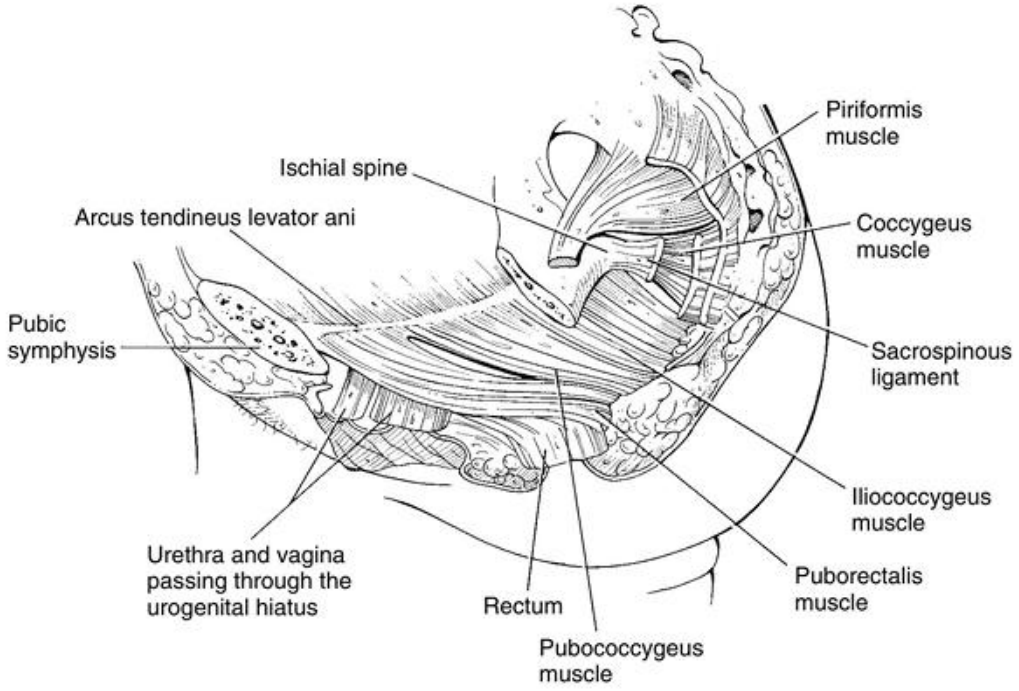
The superior and inferior surfaces of levator muscles are covered by superior and inferior fasciae. When the levator ani muscles and their fasciae are considered together, they are called the pelvic diaphragm.

The following picture shows pelvic diaphragm viewed from below.



The dissection in subjects does not give a correct picture of the horizontal nature of the strong supportive shelf of muscle. Even under anaesthesia there can be altered relationship between muscular components . Examining the normal standing woman is the best way to appreciate the nature of the pelvic closure mechanism, because in lithotomy position there will be some relaxation of the musculature. Modem imaging methods like endosonography and MRI has helped to elucidate the area.While doing routine pelvic examination of the nullipara, the effectiveness of this closure can be appreciated, because it is often difficult to insert a speculum if the muscles are contracted and not relaxed.

Here is a picture showing the muscles of pelvic floor from lateral view.



The space that lies between the bones and muscles of the pelvic wall is covered by the muscles of the pelvic diaphragm.They are the pubococcygeal, puborectal, iliococcygeal and coccygeal muscles .The levator ani originates from a linear area on the posterior surface of body of pubis and it forms base of retropubic space.Posterolaterally its origin is from tendinous arc(white line) over oburator internus upto ischial spine.

The muscle which is most medial is the puborectalis pubococcygeal complex. The pubococcygeal portion is inserted into the anococcygeal raphe and the superior surface of the coccyx.The puborectal portion represents those inferior fibers that pass behind and insert into the

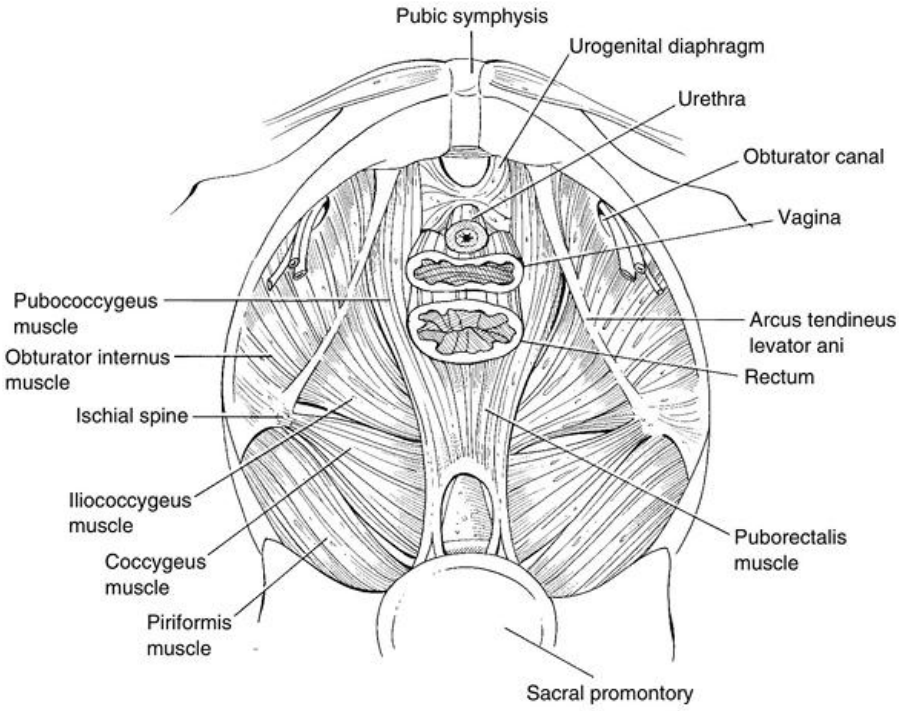
rectum. Both portions arise from the inner surface of the pubic bones and pass the urethra without attaching to it.

Some fibers attach to the lateral vaginal wall and external anal sphincter and form a sling around the rectum before returning to a similar course on the other side. The pubococcygeal portion passes posteriorly from its origin ventral to the iliococcygeal muscle, where its fibers insert between the internal and external anal sphincter muscles in the intersphincteric groove, and form a sling behind the rectum. A few fibers also run on the cephalic surface of the iliococcygeal muscle to reach the inner surface of the sacrum and the coccyx. Thus in a patient with posterior vaginal wall prolapse, if two levator muscles are brought together between vagina and rectum, not only rectocele prevented but also anal sphincter function will be improved.

The iliococcygeal muscle arises from a fibrous band overlying the obturator internus called the arcus tendineus levatoris ani. From these broad origins, the fibers of the iliococcygeal muscle pass behind the rectum and insert into the midline anococcygeal raphe and the coccyx. The coccygeal muscle arises from the ischial spine and sacrospinous ligament to insert into the borders of the coccyx and the lowest segment of the sacrum.

The muscle fibers of the pelvic diaphragm form a broad U-shaped layer of muscle with the open end of the U directed anteriorly. The open area within the U through which the urethra, vagina, and rectum pass is called the urogenital hiatus. The normal tone of the muscles of the pelvic diaphragm keep the base of the U pressed against the backs of the pubic bones, keeping the vagina and rectum closed. The region of the levator ani between the anus and coccyx formed by the anococcygeal raphe is clinically called the levator plate.

This is forming a supportive structure on which the rectum, upper vagina, and uterus can rest. The relatively horizontal position of this shelf is determined by the anterior traction on the fibrous levator plane by the pubococcygeal and puborectal muscles and is important to vaginal and uterine support.



This is a picture showing pelvic diaphragm when viewed from above.

Perineal Membrane (Urogenital Diaphragm)

Perineal membrane forms the inferior portion of the anterior pelvic floor . It is a triangular sheet of dense, fibromuscular tissue previously called the urogenital diaphragm, and it is not a two-layered structure with muscle in between, as was previously thought. It is just caudal to the skeletal muscle of the striated urogenital sphincter formerly called the deep transverse perineal muscle. The perineal membrane is not a continuous sheet to close off the anterior pelvis in the woman, as it does in the man since vaginal opening is present.The vagina divides the perineal membrane into three parts .The related superficial and deep

perineal pouches are found lateral to lowest part of vagina, where the two halves of the perineal membrane itself provide lateral support. Perineal membrane is medially attached to the urethra, walls of the vagina, and perineal body.

Urogenital hiatus

It is the large central opening in the pelvic diaphragm. The vagina, urethra, and anus exit the pelvis through this structure.

Perineal Body

Within the area bounded by the lower vagina, perineal skin, and anus is a mass of connective tissue called the perineal body also called as central tendon of the perineum.it is a wedge shaped body with its apex at the level of perineal membrane where the two halves are attached immediately posterior to lower end of vagina. Base is formed by perineal skin extending from navicular fossa to anterior anal verge.

The perineal body is attached to the inferior pubic rami and ischial tuberosities through the perineal membrane and superficial transverse perineal muscles. Anterolaterally, it receives the insertion of the bulbocavernous muscles. On its lateral margins, the upper portions of the perineal body are connected with some fibers of the pelvic diaphragm.

Posteriorly, the perineal body is indirectly attached to the coccyx by the external anal sphincter that is embedded in the perineal body, and it is attached at its other end to the coccyx. These connections anchor the perineal body and its surrounding structures to the bony pelvis and help to keep it in place.

Endopelvic fascia

The connective tissues of the pelvis are collectively known as the endopelvic fascia. The deep endopelvic connective tissue is situated between the dependent portion of the pelvic peritoneum and the superior fascia of the pelvic diaphragm. This continuum of tissue helps to support, suspend, and separate the central pelvic organs. This is a fibroelastic connective tissue matrix which contains varying amounts of smooth muscle.

It supports and invests all the midline organs and structures of the pelvis. Only the ovaries and fallopian tubes lie outside this investment. At various locations, the endopelvic fascia manifests different characteristics. These forms include loose areolar tissue capable of distention, neurovascular sheaths, septa and ligaments that support, suspend, and separate the pelvic organs, and dense skeletal muscle investments. In the central pelvis, the visceral peritoneum drapes over the

midline structures, dipping into recesses but not descending into direct contact with the muscular pelvic floor. The irregular space between the pelvic diaphragm, the muscular pelvic sidewall, and the visceral peritoneum is the location of the endopelvic fascia. The endopelvic fascia is divided into three parts: parietal fasciae, visceral fasciae, and deep endopelvic connective tissue.

The pelvic floor is sub divided into 3 compartments: the anterior compartment consists of the bladder and urethra; the middle compartment consists of the vagina, cervix, and uterus; and the posterior compartment consistes of the rectum. These compartments are supported by a complicated network of muscles and fascia that forms the pelvic floor.Any damage occurring to one or more of these myofascial elements can lead to single or multiple organ prolapse. When there is overall laxity, tearing and stretching generalized pelvic floor relaxation can occur.

Parietal Pelvic Fasciae

These include:

- Obturator fascia
- Levator ani fascia (Superior fascia of the pelvic diaphragm)
- Coccygeus fascia (Sacrospinous ligament)

- Piriformis fascia

Visceral Pelvic Fasciae

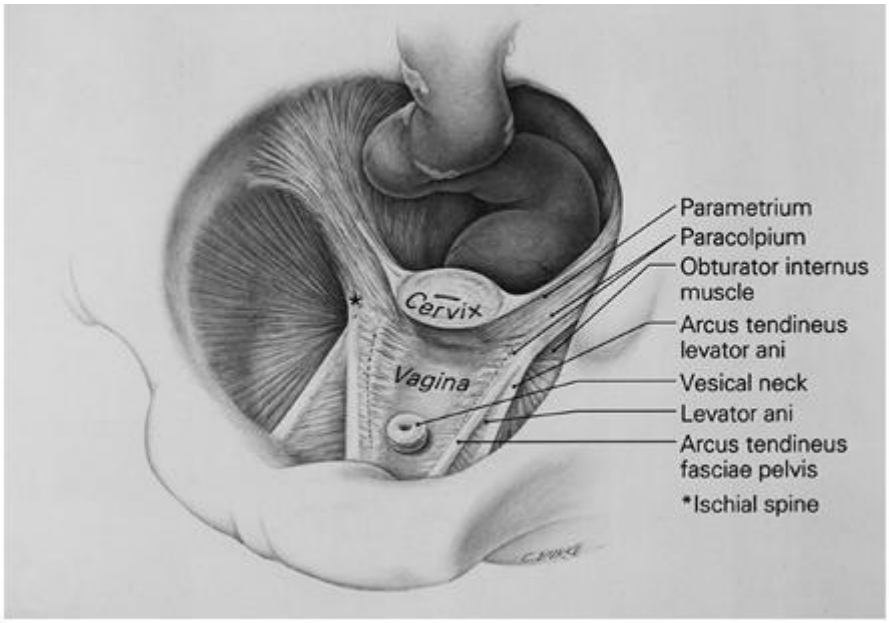
Pelvic organs and structures invested by visceral fasciae -Vagina,Uterus,Bladder,Rectum

Pelvic organs and structures not invested by visceral fasciae -Fallopian tubes, Ovaries

Components of the Deep Endopelvic Connective Tissue:

- **Uterosacral Ligaments** -Rectal pillar : In its insertion into the pericervical ring, the uterosacral ligaments blend as continuous structures superiorly and laterally with the cardinal ligaments and distally with the proximal rectovaginal septum
- **Cardinal Ligaments-** Mackenrodt's ligament, lateral cervical ligament, and proper cervical ligament
- **Pubocervical Ligaments-** Bladder pillar
- **Pubocervical Septum or Fascia**
- **Rectovaginal Septum or Fascia-** Denonvilliers' fascia
- **Pericervical Ring-** Supravaginal septum

The following picture shows three dimensional view of endopelvic fascia.



3 D view of endopelvic fascia

The deep endopelvic connective tissue is of utmost importance in the applied anatomy of the pelvis and is specifically important to the pelvic reconstructive surgeon. This structure is continuation of retroperitoneal connective tissue that is extending from the respiratory diaphragm in the upper abdomen to the pelvic diaphragm. The main structures of the deep endopelvic connective tissue are six ligaments, two septa, and one ring. Paracolpium is formed by the six pericervical ligaments . The main effect of these structures is the suspension of the cervix in the posterior pelvis and the subsequent placement of the vagina directly over the levator plate and away from direct exposure to the urogenital hiatus.

Two septa or fasciae are situated in the deep endopelvic fascia. These condensations of fibroelastic connective tissue are in close contact with the vaginal epithelium and visceral fasciae of the adjacent organs. Clinically, they are separate from their adjacent structures. When the septa and their supports are intact, the vaginal and rectal axes have a posterior angle of approximately 130 degrees at the anterior point of their suspension over the levator plate. Distal to the puborectalis muscle, the vagina is nearly vertical as it passes through the urogenital hiatus. The apical or proximal two thirds of the vagina is nearly horizontal and is suspended over the levator plate. The normal vaginal axis is oriented posteriorly toward a point just above the center of the fourth sacral vertebra. This point is the area of the origin of the uterosacral ligaments.

The deep endopelvic connective tissue support structures converge at the pericervical ring. The ultimate aim of the defect-specific pelvic reconstructive surgery is the restoration of the anatomical connections of the pericervical ring.

Biomechanics of pelvic organ prolapse

DeLancey's biomechanical analysis of normal uterovaginal support by the deep endopelvic connective tissue helps to unify the anatomic principles pertinent to pelvic organ dysfunctions.Tthe potential for pelvic

organ prolapse became more likely because of gravitational stress during the transition to upright bipedal position in the process of evolution. In normal women, a lordosis of the lumbosacral portion of the spine places the pelvic inlet in an oblique orientation reminiscent of the pelvic posture of a quadruped.

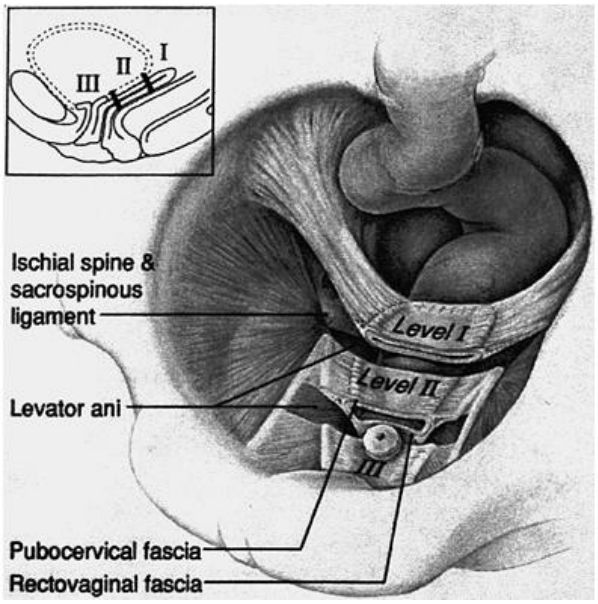
The physical result of this shift is that the posterior aspect of the pelvic inlet is approximately 60 degrees above the anterior aspect . This partially vertical orientation of the pelvic inlet deflects force onto the superior symphysis pubis rather than directly on the pelvic outlet and urogenital hiatus. Consequently, the pelvic outlet is partially shielded from downward stresses in the anatomically normal woman.

DeLancey described three levels of vaginal support .

Proximal vaginal level I support is attributed to suspension by the ligaments of the paracolpium. Damage to level I support results in uterovaginal prolapse, posthysterectomy vaginal prolapse, and enterocele. The cause for level I support problems is at or above the level of the ischial spines. The primary load-bearing elements are the uterosacral ligaments and, to a lesser extent, the cardinal ligaments. Prolapse occurs only after atleast 85% of the integrity of the paracolpium is lost.

Midvaginal level II support is by the lateral attachment of the fascial septa to the pelvic sidewalls. The septa gets attached to the arcus tendineus fascia pelvis and to the arcus tendineus fasciae rectovaginalis. Damage at this level results in paravaginal and pararectal defects.

Level III support is due to fusion to the urogenital diaphragm anteriorly and to the proximal perineum posteriorly. Damage at these sites results in urinary incontinence anteriorly and in perineal body deficits posteriorly.



Supports of uterus

The normal uterus is in anteverted and anteflexed position with external os at the level of ischial spines.It is held in this position and at this level by three tier system of supports

- Endopelvic fascia covering the uterus

- Round ligaments
- Broad ligament with intervening pelvic cellular tissue

The last two structures act together by guy rope mechanism.But they help only in steadying the pelvic organs but not preventing pelvic organ prolapse.

The Middle tier

-Pericervical ring

-Collar of fibroelastic tissue surrounding supravaginal cervix

It is connected to pubocervical ligament and vesicovaginal septum anteriorly,

Cardinal ligaments laterally, uterosacral ligament and rectovaginal septum posteriorly

Inferior tier

It is an indirect support to the uterus.

The support is principally given by pelvic floor muscles(levator ani), endopelvic fascia , levator plate, perineal body and urogenital diaphragm.

Supports of vagina

Anterior vaginal wall

Positional support :

Vagina is not a vertical canal. It is directed obliquely upwards and backwards from vulva at an angle of 60 to 70 degree to horizontal. Therefore any increase in intraabdominal pressure will have closing effect on vagina, causing anterior and posterior walls to appose.Vagina is not a straight canal .It is actually angulated at its midway called vaginopelvic angle, which again is a protective factor in prevention of prolapse.vagina is not a canal at all. Lumen is H shaped, with anterior and posterior walls in apposition , lateral wall attached to lowermost parts of meckendrots ligaments.Vagina is strongly supported by endopelvic fascia condensation.

Posterior vaginal wall

It is supported by Levator ani,Levator plate,Perineal body.Defect in upper third of posterior wall causes primary or secondary vault prolapse and enterocele. Defect in middle third causes rectocele and lower third causes lax perineum and gaping introitus.

Complex muscular apparatus formed by levator ani and urogenital diaphragm forms a dynamic support system.This system is mediated by by a toni and phasis reflex activity by TYPE 1 (fast twitch) and TYPE 2 (slow twitch) muscle fibres integrated at central nervous system.This comes into action for every effort involving valalva maneuver like coughing, defecation and sneezing. Any situation increasing intra abdominal pressure to 100 cm of water adds strain on pelvic supporting system.

The muscles of the pelvic diaphragm primarily provide pelvic support. These muscles form a basin or covering of the pelvic outlet and are often grouped together as the levator ani or levator sling .

Etiology

In majority of women who develop pelvic organ prolapse, the process begins with their first vaginal delivery. Labor aided by maternal pushing and, at times, by physician traction has a damaging effect on the intricately constructed support structures of the pelvis.The fetal head engages, flexes, and descends to a point immediately proximal to the interspinous diameter.At this point of time, great pressure is applied to the anterior vaginal segment.

As the fetal head overcomes the resistance of the pubocervical septum, significant downward pressure is placed on the maternal right pelvic sidewall. This event likely explains the preponderance of full-length right paravaginal paravesical defects as the most common fascial defect in anterior vaginal relaxation. This change in orientation when the fetus becomes occipito anterior places intense pressure on the posterior pericervical ring. This usually results in further uterosacral stress and a transverse proximal detachment of the rectovaginal septum at its junction with the pericervical ring.

As extension of the head progresses, displacement of the rectovaginal septum toward the perineum results in the creation of a nidus for proximal vaginal enterocele and midvaginal rectocele formation. If the rectovaginal septum is displaced far enough distally, pararectal defects form as the septum is sheared away from its lateral attachments. The process of rectovaginal detachment and displacement weakens proximal support for the perineal body and predisposes to perineal descent. Subsequent deliveries progressively contribute damage to the endopelvic fascia. During descent and extension, the fetus passes through the urogenital hiatus. During this process, pressure is transmitted to the levator muscles and the pudendal nerve. A nulliparous prolapse would

likely suffer from isolated failure of the paracolpium, with the pericervical ring and fascial septa remaining intact.

Pelvic organ prolapse is found to be more common with increasing age. The most likely cause is general weakening of tissues, including the pelvic floor muscles. Passage of time increases the cumulative effect of contributing causes on the pelvic floor. In most of the patients prolapse become evident after the age of menopause. Almost all the tissues of the pelvis contain estrogen receptors, and the atrophic changes that occur in the absence of estrogen are a contributing cause for prolapse.

Post menopausal osteoporosis causes kyphotic changes in the spine.It displaces the pelvic inlet into a more horizontal plane. This change in the pelvic inlet causes the weight of the abdominal contents to act more directly on the pelvic floor and on the urogenital hiatus.

Lifestyle alsocontributes to development of pelvic floor dysfunctions. Lifting objects heavy enough to require a Valsalva maneuver or fixation of the respiratory diaphragm displaces stress directly down on the pelvic floor. Defecation or micturition are commonly assisted with straining. This straining occurs when the pelvic diaphragm is intentionally relaxed. This action places substantial force on a passive pelvic floor and opens urogenital hiatus several times a day.

Straining has essentially the same effect as heavy lifting. Obesity, directly increases the load on the pelvic floor and decreases mobility, as well as the ability to do muscle strengthening exercises.

The progression of diabetes mellitus includes neuropathy and obesity, both of which contribute to the tendency for pelvic organ prolapse. Chronic cough accompanying asthma, bronchitis, or smoking places repeated stresses on the pelvic floor. Smoking also has antiestrogenic properties, contributes to vascular disease, and creates a chronic hypoxic state. Corticosteroid therapy is used in many chronic medical conditions. Ehlers-Danlos syndrome is characterized by generalized fascial and connective tissue weaknesses.

Development of ascites may cause a rapid increase in the degree of prolapse. Any condition that affects the physical load on the pelvic floor or the integrity of the muscular and connective tissues of the pelvis will increase the chance of developing prolapse.

Some medical conditions may decrease the tendency to develop prolapse. This is for any condition that causes an inflammatory reaction in the paracervical or parametrial tissues with consequent tissue fibrosis. Pelvic inflammatory disease, puerperal or postabortal sepsis, endometriosis, and pelvic radiation therapy are conditions that can

decrease incidence of prolapse. Pelvic adhesions may be dense and numerous enough to secondarily suspend a prolapse. Large uterine leiomyomata or other pelvic masses can mechanically prevent the development of pelvic organ prolapse.

Prevention

Prevention must be started as early as possible in a woman's life and should be continued into the later yearsMostof the measures considered as preventions have a positive effect on a woman's general health. Prevention must include the obstetric management of childbirth. Vaginal delivery no doubt has a primary and profound effect on pelvic support anatomy.

In an adult parous woman, strategies to prevent the development of prolapse lie on efforts that will reduce physical stress on the urogenital hiatus and strengthen the pelvic floor.Undue stress should not be placed on the pelvic floor. The control of obesity is a must and should be considered part of the effort to decrease the load placed on the pelvic floor. Estrogen therapy may be helpful in the following way.It not only prevents osteoporosis but also has positive effects on the various estrogen-sensitive tissues of the pelvis. Pelvic floor strengthening by voluntary contraction of the muscles innervated by the pudendal nerve

was popularized by Arnold Kegel which have been discussed later in detail.

CLINICAL FEATURES

SYMPTOMS[10]

- Constipation
- Sense of incomplete evacuation[6]
- Fullness in the vagina
- Mass descending pv at rest and straining
- Bowel symptoms-faecal incontinence
- Sexual dissatisfaction
- Backache
- Discharge pv
- Chronic pelvic pain for more than 6 months
- Urinary symptoms
    - ✓ Urinary frequency-more than 2 nd hourly
    - ✓ Urgency, retention, hesitancy and/or incomplete empyting
    - ✓ Nocturia
    - ✓ Pain in the urethra
    - ✓ Pressure sensation,
    - ✓ Spasming,

- ✓ Difficulty with initiating urination
- ✓ Weak urine stream
- ✓ Levator Ani Syndrome- patient may have pain, ache or pressure sensation in the pelvic bones sacrum, coccyx, vagina and/or rectum. It is due to excess tension in the levator ani muscles.
    - o It increases in severity with sexual intercourse, sitting, defecation, and constipation
    - o Pain may be referred to the legs,thigh or back bones or gluteal region
    - o Patient may complain of severe,cruciating, sharp, burning, or ache while urinating.

The most common presenting complaints of the various pelvic floor dysfunctions in the order of frequency are urinary complaints, mass descending PV,bowel symptoms,pressure/pain symptoms.Hence this study intends to study the patients attending the gynaec OPD with the common symptoms of pelvic floor dysfunctions.

CLINICAL EVALUATION

Proper treatment of pelvic floor dysfunctions depend on meticulous evaluation of every patient. A thorough history and physical examination is the key for evaluation.

The history must be started by knowing the patient's perception of the problem. The various types of incontinence like Stress, urge, and neurogenic bladder can be distinguished by history.The mechanisms that are involved in defecation are equally significant.History should be asked to know the number of trips to the toilet and the various compensatory mechanisms needed for completing evacuation. Fecal incontinence may or may not be due to physical damage to the anal continence control mechanism.Significant differences occur in patients' sexual goals.An elaborate history about previous surgeries is important.

A good physical examination of the patients with pelvic floor dysfunction necessitates that the examining physician should have a working knowledge of normal pelvic anatomy. Older systems classified prolapse as mild, moderate, and severe. These terms have a limitation to accurately describe the degree of prolapse and restrict effective communication between 2 different persons evaluating the case. 2 systems are presently in use that aids in a complete examination of

pelvic organ prolapse and that are more objective to record the anatomic details. Each of these systems has their own pitfalls .

PELVIC EXAMINATION

Pelvic organ prolapse can be evaluated after a general physical examination is done. Any surgical scars on the abdomen should be noted. Particular attention should be paid to the suprapubic region where previous incontinence procedure incisions might be found.

The pelvic examination should be started with the patient in the lithotomy position. Hip mobility must be checked because adequate abduction and flexion of the thighs is necessary for a vaginal procedure. Obesity in thigh and buttock region may also be a hindrance.[9]

The labia are separated for the sake of introital inspection. Pelvic organ prolapse can be internal (proximal to the hymen) or external (distal to the hymen) when the patient is at rest. The extent of the pelvic organ prolapse may change considerably when the patient is asked to strain. This difference can be significantly pronounced in patients who have healthy pelvic floor muscles and an undescended levator plate.

These are the main structures help hold a prolapse in place.when the patient gives a history of a prolapse that is not evident on examination or not as large as she describes, the patient must be

examined while she is in the standing position; else she may be asked to perform the maneuvers necessary to demonstrate the full extent of the prolapse

The dominant pelvic organ prolapse the first hernia to descend or the most dependent part of a prolapse that has already descended. Correct identification of the dominant prolapse provides important clues about where the most significant fascial damage is situated. The dominant prolapse is identified and replaced back to continue examination of the rest of the vaginal vault. A large dominant prolapse usually fills the urogenital hiatus and introitus, preventing incipient hernias from fully developing. Usually an anterior prolapse is easily relocated and repositioned by the placement of a tongue blade or Ayre spatula in each anterior lateral sulcus.[8]

When an apical transverse or lateral paravaginal defect is there, this maneuver replaces the anterior vaginal wall. If this maneuver does not reduce the hernia, a central anterior defect is likely present. A dominant posterior segment prolapse may be repositioned with the posterior blade of a Sims' speculum. A dominant superior segment prolapse may be replaced with a large cotton swab, a sponge stick, or, in advanced cases, by attaching a tenaculum to the cervix. After the dominant prolapse is replaced, the other sites of prolapse become much

more evident. An isolated single-site prolapse is rare to occur. The location of the dominant prolapse can be made out also with the help of the location of cervix or hysterectomy scar.

The scar following a hysterectomy is usually a transverse fibrous band that can be slightly retracted. On each side of the band are dimples in the epithelium corresponding to the location of the insertion of cardinal and uterosacral ligament remnants. Incomplete and inadequate evaluation often leads to incomplete anatomic repair that results in recurrent prolapse and multiple trips to the operation theatre. The various levels of support structures of all segments and levels are dependent on each other. Proper and complete restoration of all the fascial defects is ideal for a successful and favourable outcome.

Vaginal epithelium should be inspected meticulously for the location of rugae. The presence of 3 transverse folds conveys that the endopelvic fascia is adherent to the epithelium in that particular site. The lateral vaginal sulci are the sites where there is a junction of the pubocervical and rectovaginal septa to their corresponding lateral arcuate attachments. The pattern of rugae and the condition of the sulci must correlate with the pattern of fascial breaks found at surgery. The vaginal epithelium must be looked for atrophy created by the absence of estrogen

effects.Look for pressure ulcers is a must. Those lesions if present should be properly evaluated to rule out malignancy.

A rectovaginal examination helps in the evaluation of the superior and posterior vaginal segments. Palpation of uterosacral ligaments can be done immediately medial to each ischial spine,mainly if the uterus is present. These uterosacral ligaments can be more easily palpated with traction on the cervix.Displacement of the rectal examining finger anteriorly towards the vagina guides in distinguishing between rectocele and enterocele. While doing the rectal examination, the patient should be asked to strain. When an enterocele is present, it bulges down in the nonrugated vaginal epithelium proximal to the tip of the examining finger.In addition perineal descent must be evaluated while performing the rectal examination. The levator plate which lies immediately posterior to the rectum must be horizontal and not movable. The perineumshould be the last to get evaluated. The perineum is triangular in the sagittal plane. The base of the perineum will be on the rectal side, and the apex will be at the hymen.

The integrity of the external anal sphincter can be tested by apposition of the thumb of the examining hand while the index finger is in the rectum proximal to the anterior aspect. Voluntary contraction of the sphincter can be of some help.

The mechanical strength of the pelvic diaphragm can be directly proportionately correlated with the ability to voluntarily contract these muscles. This property can be best studied clinically with a light pressure applied over the posterior vaginal wall with the examining fingers.This time must be the best opportunity to instruct the women about the importance of postvoiding Kegel exercises and the role of perineal support (splinting) during defecation[9].

For eliciting muscle activity it may subjectively be given grading from 0 to 4.Magnetic resonance imaging of these patients has shown the presence of muscle atrophy in advanced stages and muscular detachments also.When the patient has difficulty in moving her toes and contracting the levator muscles, a spinal cord or central nervous system disorder must be considered.[9]

The signs of urinary incontinence must be made a note while examining a case of prolapse. In an advanced disease, the evaluation of incontinence is best conducted with the prolapse in a reduced state. For carrying this out,a pessary or loose vaginal packing may be useful. Incontinence might be masked by a hypotonic bladder or reverse kinking of the urethra if the cystocele is bigger in size. Appearance of urinary incontinence can occur following repair of a large prolapse if the

preoperative evaluation is not performed properly after reducing the prolapse.[9]

CLASSIFICATION

Pelvic organ prolapse can be classified **based on the level of defect**

Level-1-descent of cervix

-Enterocele

-Apical/vault prolapse

Level-2-cystocele

-Rectocele

Level-3-Gaping introitus

-Deficient perineum

-Urethrocele

Anatomical classification of pelvic organ prolapse

Normal-cervix at the level of ischial spines

First degree-Cervix below the ischial spines but above the introitus

Second degree-Cervix at the level of introitus

Third degree-Cervix outside the introitus

Procidentia-Uterine fundus outside the introitus

Anterior and posterior vaginal wall prolapse

Cystocele-bulge in the upper two thirds of the anterior vaginal wall

Urethrocele-Bulge in the lower third of anterior vaginal wall.

Enterocele-Bulge in the upper one third of the posterior vaginal wall

Rectocele- Bulge in the middle one third of the posterior vaginal wall

Deficient perineum-distance between the introitus and anal verge is decreased.

Anterior Vaginal wall prolapse

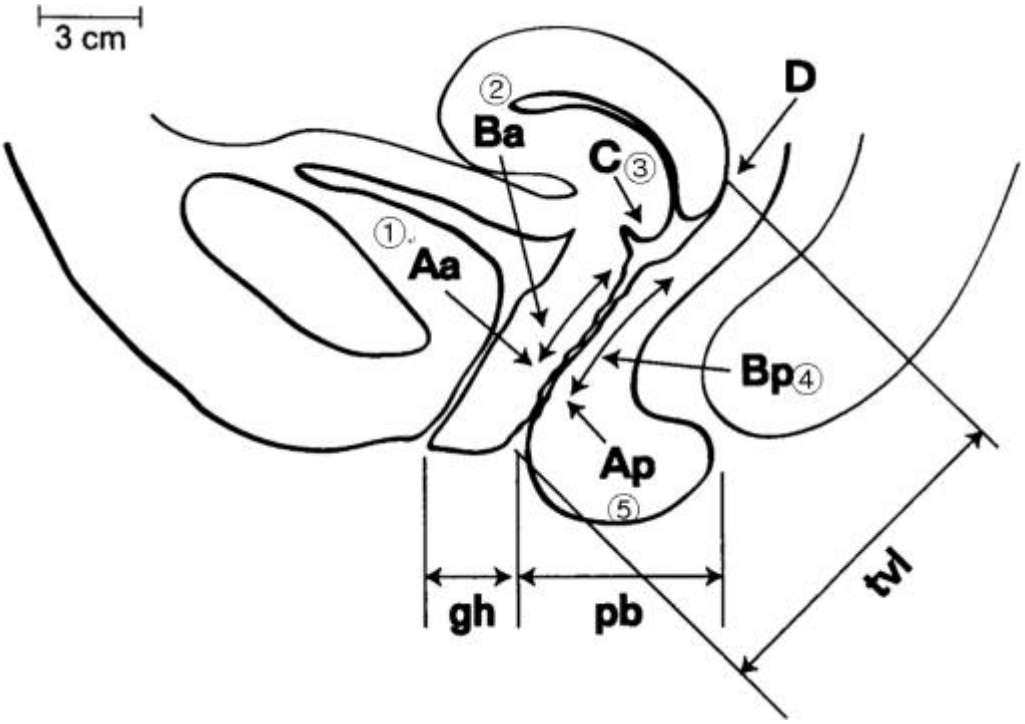
Distension

-central defect- due to attenuation of vaginal wall. Rugae will be lost

Displacement

-paravaginal defect- due to loss of attachment to pelvic side walls

The classical classification and quantification system is the POP-Q which is the pelvic organ prolapse quantification system for universal grading and quantification of organ descent. It is a more complicated system which incorporates more specific details of the physical findings.



Anterior wall Aa	Anterior wall Ba	Cervix or cuff C
Genital hiatus gh	Perineal body pb	Tatol vaginal length tvl
Posterior wall Ap	Posterior wall Bp	Posterior fornix D

Aa-Anterior vaginal wall midline 3 cm proximal to external urethral meatus.

Ba-Anterior vaginal wall most dependant portion between Aa and anterior fornix

C-Cervix or vaginal cuff

D-Posterior fornix or vaginal apex

Ap-Posterior vaginal wall midline 3 cm proximal to hymen

Bp-Posterior vaginal wall most dependant portion between Ap and posterior fornix

Tvl-Total vaginal length

But it has a drawback that it is cumbersome and has many inter observer variations. Even for the examiners accustomed well to its use, the number of measurements needed requires additional time to acquire.[7]

Thus the Pelvic Organ Prolapse Quantification system, a clinical examination which uses various parameters and measurements based on site-specific points, which is currently considered the gold standard for the diagnosis and assessing the degree of pelvic organ prolapse is recommended by the International Continence Society (ICS).

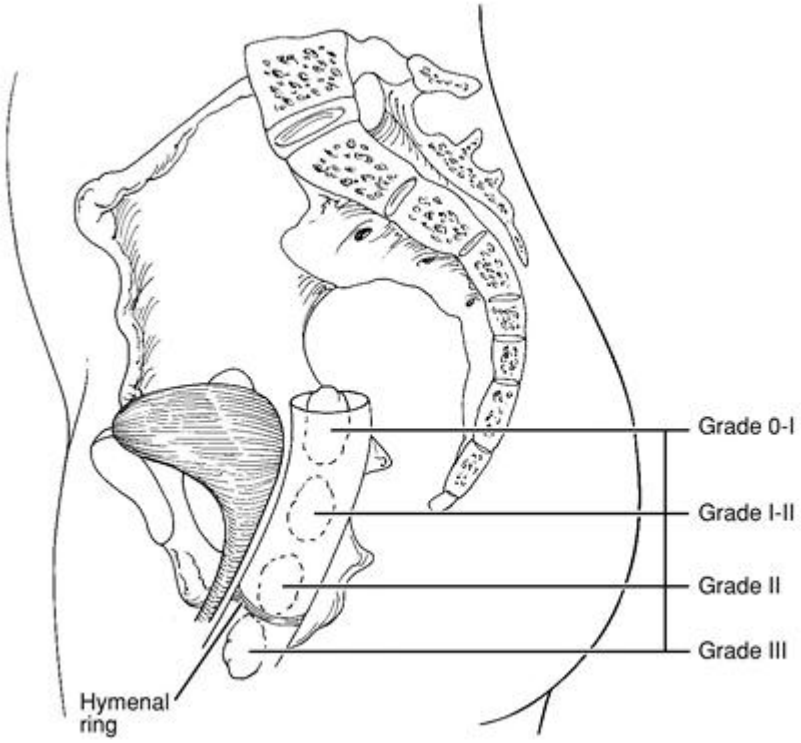
But clinical examination is found to be insufficient and inadequate and in disagreement with surgical findings, mainly for posterior vaginal wall pelvic organ prolapse.Studies show that the clinical examination for Prolapse correlated with surgical findings in only 59% of women.[13]

Therefore this study is intended to search for a better tool for universal grading and classification as well as to be a one time reading with no inter observer variation and non invasive.

Yet another classification is the Baden walker halfway system.

This is for measurement of ovarian descent. The Baden-Walker Halfway System is user friendly.It is relatively easy to measure and record, and maximizes the quality and quantities of details that can be recorded in a very brief space.[7]

- Grade 0-No descent
- Grade 1-IP ligament stretchability brings the descent of ovaries into the long axis of vagina with traction halfway between ischial spines and mid vagina
- Grade2-Between midportion of vagina and hymenal ring.
- Grade3-Past the hymenal ring



CONVENTIONAL METHODS OF EXAMINATION AND INVESTIGATIONS

The diagnosis, grading and decision making regarding management options for pelvic floor dysfunctions were performed with physical examination and radiographic imaging, such as voiding cystourethrography, evacuation proctography, cystocolpoproctography, and peritoneography in the past. Imaging is of utmost benefit in women in whom findings at physical examination are equivocal or inconclusive.

Physical examination has already been dealt with in detail.

USG pelvic floor- Though it is a non invasive method ,the dynamic MRI is proved to be superior in studies in terms of its multiplanar imaging and better soft tissue enhancement.

Voiding Cystourethrography:

For evaluation of incontinence and low-grade cystoceles, the studies that are considered are the voiding cystourethrogram (VCUG) and urodynamics. VCUG is helpful in assessing the severity of cystocele, evaluating for urethral hypermobility and stress urinary incontinence,and documenting post void residual urine. A study comparing compared chain cystourethrography with dynamic MRI showed that on pelvic straining the measurements of bladder neck descent,angle of the urethra and the posterior urethrovesical angle, were not significantly different.In the diagnosis of cystocele, MRI had a high degree of correlation to lateral cystourethrography with a Spearman correlation coefficient of 0.95 .[16]

Evacuation proctography:

For evaluation of rectoceles, evacuation proctography was used to diagnose enterocele, retoceles,perineal descent and rectal intussusception . Dynamic contrast roentography or fluoroscopic cystocolpoproctography were also been used. The main drawbacks of these techniques are the inability to visualize the soft tissue planes comprising the pelvic floor,

their invasiveness,and the exposure to significant levels of ionizing radiation.

Cystocolpoproctography:

Till recently, dynamic contrast roentography and multiphasic fluoroscopic cystocolpoproctography were considered to be the best radiologic studies for detecting organ prolapse.But these studies depend on the opacification

with contrast material of the bladder, vagina, small bowel, and rectum with all organs opacified together or in phases with each organ opacified individually before straining .These studies fail to detect up to 20 percent of all enteroceles [16]

Henceforth MRI is proving to be a much simple and non invasive technique for the evaluation of enteroceles.In addition, MRI is able to differentiate the enteroceles according to their contents (small bowel, large bowel, rectosigmoidocele or mesenteric fat). MRI has also been found to be good to differentiate high rectoceles from enteroceles.

KEGEL EXCERCISES

Arnold Kegel popularized excercises for pelvic floor strengthening by voluntary contraction of the muscles innervated by the pudendal nerve .Since then the associated excercises are known by his name. Most

patients know these excercises because they are used frequently in postpartum instructions. Several different strategies are adopted to help to make patients remember to do their Kegel exercises.

It is the voluntary contraction of the pelvic diaphragm, primarily the puborectalis muscle, and the external anal sphincter The Kegel contraction must be confirmed while doing a pelvic examination to make sure that the patient comprehends the correct muscles and the correct way to contract. Not infrequently, women perform either a Valsalva maneuver or tighten the gluteus maximus muscle instead of the external anal sphincter and levator ani muscles.

The appropriate time to perform Kegel excercises is after the act of micturition. After the patient empties her bladder she is asked to lean as far forward as her stability allows. While she is leaning forward in such a way, she is asked to do three or more isometric Kegel exercises by tightening the muscles till the muscles get voluntarily relaxed on their own. The dependent portion of a cystocele is below the level of the internal urethral orifice. Forward tilting by the patient physically elevates the bladder floor and thus helps for more complete voiding.

The action of the levator and external anal sphincter caused by the Kegel contractions also helps in the process of complete voiding.

Combining this activity with voiding makes the patient to adopt to perform the exercises several times in a day.The patient is asked to perform kegel excercises minimum 25 times per day. (atleast ten contractions thrice a day each lasting for 3-5 seconds).The ultimate advantage is the combination of more complete voiding and a strengthened pelvic floor, both of which help in tremendous improvement of the patient's symptoms.

The patient will then become capable of using the Kegel contraction during physical stress to prevent incontinence or to protect against impact of sudden rises in abdominal pressure on the pelvic floor. If the women learns the way of using Kegel muscles that are strong and easily controlled, they become an asset in her daily life.[11]

Splinting may be mainly useful in alleviating the dysfunctional defecation caused due to symptomatic rectoceles.The technique of splinting is taught as follows. The patient is asked to simply place upward pressure with her finger tips against the perineum or the area lateral to the perineum at the time of the initial urge to defecate. Rarely, the woman may also need to place one or two fingers against the posterior vaginal wall. These maneuvers help in effectively decreasing the rectocele pocket, aiding the stool to evacuate while bypassing the rectocele.[11]

SURGICAL MANAGEMENT OPTIONS:

ROLE OF CONSERVATIVE SURGERY

Conservative surgeries are indicated in the following situations

- In women desirous of menstrual and reproductive function

They may be done by

- Abdominal
- Vaginal
- Laparoscopic approach

ABDOMINAL APPROACH

- Shirodkar's sling-static closed loop posterior sling operation
- Purandare 's cervicopexy-Dynamic closed loop anterior sling surgery
- Khanna 's sling-static open neutral sling
- Virkud's-static and dynamic

VAGINAL APPROACH

- Anterior colporraphy and posterior colpoperineorraphy
- Fothergill manchester operation

- Shirodkar's modification of Fothergill's
- Nadkarni's operation
- Goodall and Power's modification of Leforte's

PRINCIPLES-SHIRODKAR'S SLING SURGERY

- Strengthening of the uterosacrals with mersilene tape and fixation to sacral promontory
- Round ligaments are then plicated.
- Rt side-A retroperitoneal space is created from sacral promontory to the cervix posteriorly

Mersilene tape is passed through Shirodkar's needle and is fixed to the posterior aspect of isthmus.

- Lt side-Peritoneum over psoas muscle is incised.

  Psoas loop is made with mersilene tape and knot is placed lateral.
- Retroperitoneal space created
- Ends of mersilene tape passed through space and loop created from the posterior surface of isthmus.
- Sigmoid colon is palpated and elevated.

- Shirodkar's needle is passed through avascular space above ureter.

PURANDARE'S CERVICOPEXY

The main principle is anchoring the anterior aspect of the uterine isthmus to the anterior abdominal wall with the help of mersilene tape.

KHANNA'S SLING

The main principle is fixation of mersilene tape posteriorly to the uterine isthmus and anteriorly between the two leaves of broad ligament via internal inguinal ring to the periosteum of ASIS.

VIRKUD'S COMPOSITE SLING

The principles are as follows:

- On the right side-Mersilene tape is fixed posteriorly to anterior longitudinal ligament over sacral promontory and fixed to posterior aspect of uterine isthmus.
- On the left side-Mersilene tape is fixed to uterine isthmus anteriorly and via the inguinal ring to the rectus sheath.
- This is followed by the plication of uterosacrals

FOTHERGILL'S OPERATION

The main principles are:

- Preliminary D&C
- Amputation of cervix.
- Plication of Mackenrotz in front of cervix
- Anterior colporraphy
- Posterior colpoperineorraphy
- Vaginal sterilisation if necessary

VAGINAL HYSTERECTOMY WITH PELVIC FLOOR REPAIR has traditionally been the treatment for all patients with third degree prolapse.But the idea needed at this point is the concept and significance of site specific repair.

Here I would like to elaborate the principles of site specific repair and hence highlight the importance of pre operative planning so as to give a complete cure without recurrence.

HISTORY OF SITE SPECIFIC REPAIRS

In the 1960s, Baden and Walker of Texas began to systemize a new defect-specific approach to pelvic organ prolapse repair. The goal was

directed to return all vaginal supports to their original anatomic status. Many other surgeons have contributed to this powerful concept of pelvic reconstructive surgery. A. Cullen Richardson and associates of Georgia developed the concept of classifying fascial defects as proximal, distal, central, and lateral.

This observation and the teaching of such master surgeons as David H. Nichols of New England encouraged gynecologists to not only identify and repair each vaginal defect but to return support attachments to their original anatomic location. Emphasis was focused on the hernial nature of prolapse and led to the abandonment of absorbable suture in favor of permanent suture in repairs. In the 1990s, pelvic anatomist John O. L. DeLancey of Michigan published a biomechanical analysis of normal vaginal anatomy. His observations have the precision of an engineer's work and identify specific structural goals for each of three vaginal levels of support. Proximal vaginal suspension, midvaginal lateral attachment, and distal vaginal fusion to the perineum and urogenital diaphragm are the basic concepts that modern pelvic surgeons must satisfy to successfully complete a prolapse surgery.But until recently there is no evidence to support that clinical examination would alone suffice to diagnose all defects in the fascia.Thus arises the role of

Dynamic MRI of the pelvic floor which helps to classify all defects with a better accuracy and little inter observer or subjective variation.

SITE SPECIFIC REPAIR OF CYSTOURETHROCELE

- Support of the bladder is the function of the pubocervical septum.
- The linear attachment of the pubocervical septum with the white line forms the anterior lateral sulci of the vagina
- Paravaginal defects are created when the pubocervical septum is separated laterally from the arcus tendineus fascia pelvis(ATFP).

An anterior midline vaginal incision begins the surgery.Incision extended distally to the plane where pubocervical septum fuses with urogenital diaphragm and dissection is proceeded in the vesicovaginal space.Palpate the white line adjacent to its terminus at the ischial spine. After dissection is completed,inspection is started for fascial defects. Paravaginal sutures are placed to connect ATFP to lateral edge of pubocervical septum.

The retro pubic space of Ritzier can be approached either abdominally or vaginally.Vaginal requires more technical expertise.

POSTERIOR DEFECT REPAIR

The principles of posterior colporrhaphy are as follows

- Defects-Linear vertical midline tear or vertical paramedian breaks in upper,middle or lower aspects are identified. These defects are repaired along with restoration of integrity of septum.
- Perineal body reconstruction-pubococcygeus pubovaginalis muscles on either side should be plicated in midline 4-5 cm above the hymenal ring.

SITE SPECIFIC REPAIR OF RECTOCELE

- After opening the posterior vagina,a rectal examination is performed.
- Defects are identified and corrected by plication of rectovaginal fascia in these areas

In nut shell,the basic surgical principles to be followed are:

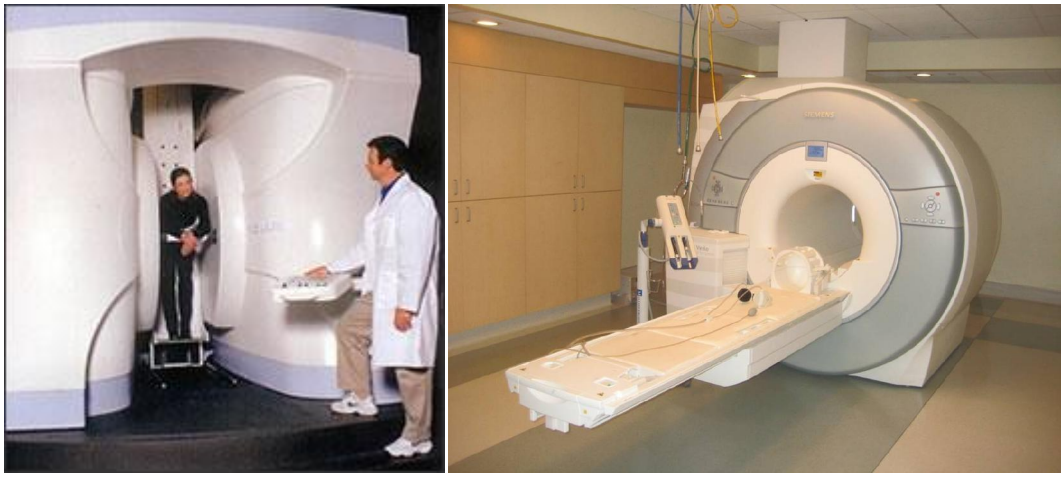
- Damage to lower supporting structures resulting in cystocele and midvaginal/low rectocele-Anterior colporrhphy and posterior colpoperineorrhaphy

- Middle and lower supports damage-cystocele,rectocele,enterocele with elongation of cervix-Hysterectomy/Fothergills with high ligation of POD,suspension of vault to uterosacral Mackenrotz ligament,anterior colporrhaphy and posterior colpoperineorrhaphy.
- Damage to all three levels-hysterectomy,vault suspension,sacrospinous fixation,anterior colporrhaphy and posterior colpoperineorrhaphy.

Hence the need for complete understanding of the defects in the endopelvic fascia is significant before planning a surgery.One of the tools that may be considered is the MRI of the pelvic floor.This study henceforth is put forward to know the anatomic changes in various types of pelvic floor dysfunctions.

MRI:

MRI is superior because of its capability of soft tissue contrast.It helps in visualizing the pelvic floor anatomy in detail.Recently there is dynamic MRI that helps in dynamic visualization of the pelvic floor.The main landmark is the pubo coccygeal line (PCL). It extends from the inferior margin of the symphysis pubis to midway between the frst and second coccygeal segments.The movement of the various pelvic organs below this line is studied.



The second of the above picture shows dynamic MRI in supine position and the first is dynamic MRI in standing position which is even more a latest application.

The movement of various pelvic organs below the pubococcygeal line (PCL) is studied.The puborectalis hiatus is defined by a line which is extending from the lowermost aspect of the symphysis pubis to the puborectalis muscle. In the normal individuals, the puborectalis hiatus is usually less than 6 cm and does not descend more than 2 cm below the pubococcygeal line . The upper urethra, urethrovesical junction, bladder, upper vagina, uterus, small bowel, sigmoid colon, mesenteric fat, and rectum must all be above the hiatus.

The staging and grading of pelvic organ prolapse is done in 2-cm increments below the puborectalis hiatus. Small is defined as when 0 to 2 cm below, moderate is when 2 to 4 cm, and a large prolapse extends >4 cm below this line.[14]

The defects occurring in the pubocervical fascia decreases the bladder support and lead to cystocele formation. This fascia is attached to the cervix posteriorly and to the arcus tendineus fascia pelvis anterolaterally. Three types of defects may occur in the pubocervical fascia:

1. lateral or paravaginal defects occur when the pubocervical fascia detaches from the arcus tendineus fascia pelvis

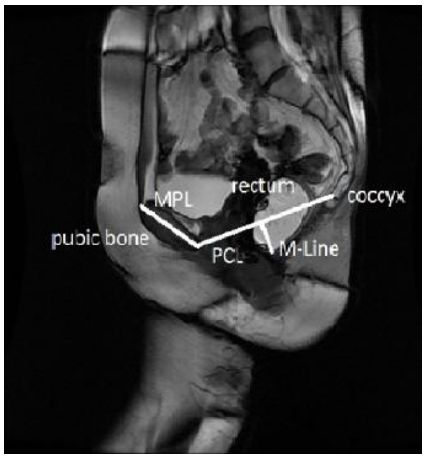
2. transverse defects occur when the pubocervical fascia detaches from its central attachment at the pericervical ring of fibrous tissue

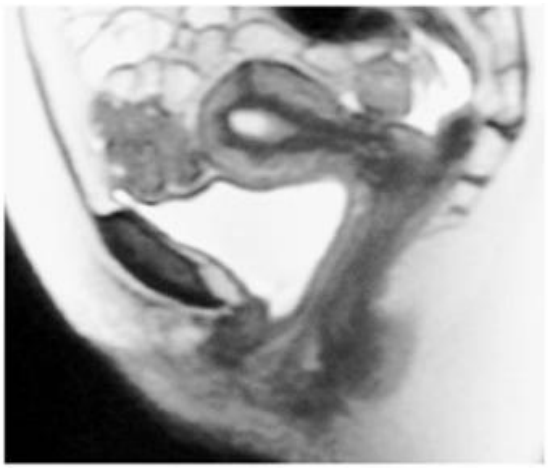
3. central defects occur when the pubocervical fascia is disrupted in the midline under the bladder base.

Radiologically,the level of the pelvic floor is determined by the pubococcygeal line.In normal persons,the levator plate must be parallel to the pubococcygeal line.There are two main reference lines used which are H line and M line.These lines are used in various types of pelvic floor dysfunctions and the organ prolapse can be identified and staged.The H line is measured as the distance from the inferior pubic symphysis to the posterior anorectal region on a mid sagittal image and it indicates the anteroposterior width of the levator hiatus.

The M line is drawn perpendicular from the pubococcygeal lineto the most distal aspect of the H line and it indicates the descent of the hiatus from the pubococcygeal line.The normal values in normal individuals are :**H line-5cm and M line-2 cm.**[13]

The presence of pelvic organ prolapse causes sloping of levator plate and increases in H line and M line. These indicate the widening and descent of the levator hiatus. Eventhough these are useful indictors in quantifying the pelvic organ prolapse little is described in literature about quantifying severity using this. Hence this study is attempted to study the various anatomic changes in different degrees of prolapse using MRI.[13]





These two pictures show normal pelvic floor MRI with organs in place

ADVANATAGES OF MRI

Pelvic floor dysfunctions include a variety of fascial and anatomic defects which may affect the anterior wall, posterior wall, and apex of the vagina. Since cystocele, rectocele, uterine prolapse, enterocele, vault prolapse, and urinary incontinence tend to exist together, it is very important to thoroughly evaluate all components of the pelvic floor. Studies show that even though patients present with symptoms suggestive of isolated pelvic floor compartment dysfunction, most of these patients have concomitant defects in other compartments as well[13]

Most of the surgical failures have been attributed to the lack of a thorough preoperative evaluation of the female pelvis and to insufficient diagnosis and staging of the various pelvic floor dysfunctions. An accurate diagnosis of the coexisting defects is very much necessary in planning reconstructive and anti-incontinence surgical procedures. This fact highlights the importance and advantage of MRI.

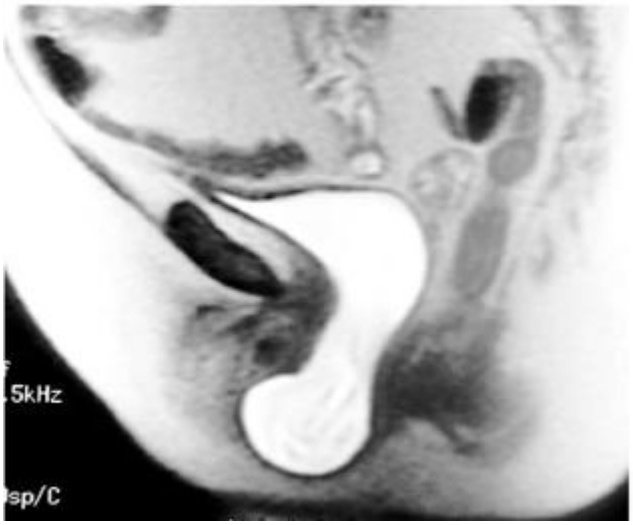
Imaging can be beneficial in women in whom physical findings are equivocal. The major advantages of MR I include lack of ionizing radiation, better demonstration of the soft tissues of the pelvic floor, and capability of multiplanar imaging. The advent of fast MRI sequences has aided in the quick evaluation of pelvic organ prolapse and pelvic floor

relaxation with better patient comfort, decreased complexity, invasiveness and without radiation exposure.

MRI has intrinsic soft tissue contrast capability. This allows for visualization of the pelvic floor in depth, and the faster techniques allow for dynamic evaluation of the pelvic support structures. It is a single non-invasive study which has nil exposure to ionizing radiation. MRI also gives a multiplanar thorough evaluation of all the pelvic contents including the uterus, ovaries, ureters, kidneys, and levator muscles, as well as the urethra, which are not available by any other imaging modality.

Cystocele:

In MRI, the bladder's posterior wall descends along an arc, initially moving posteriorly and inferiorly to deform the anterior wall of the vagina and then bulges forward when it exits the introitus .The anterior wall of the bladder remains relatively stationary as is fixed by the median umbilical ligament to the anterior abdominal wall. This gives an elongated appearance to the bladder. When there is midline defect in the pubocervical fascia, there is a focal midline protrusion of the bladder anterior to the vagina seen. The bladder can even prolapse completely to lie outside the pelvic cavity.



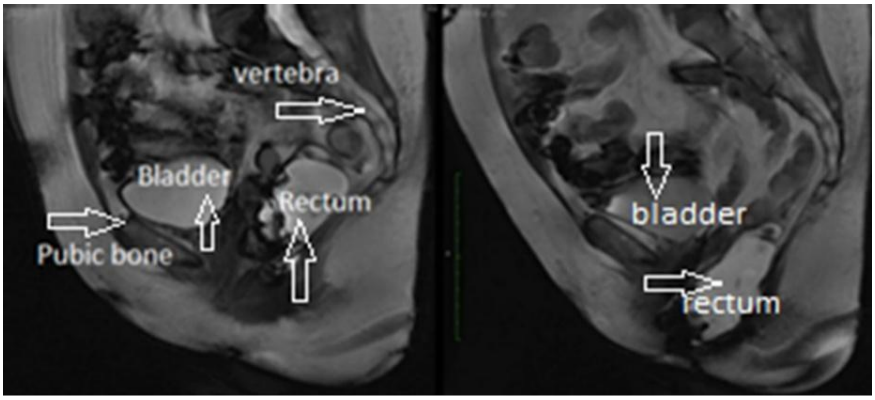
Criteria which are proposed for diagnosis and grading of cystocele in MRI are:

- bladder below the pubic symphysis
- bladder below the pubococcygeal line
- bladder more than 1 cm below the pubococcygeal line.

Rectocele:

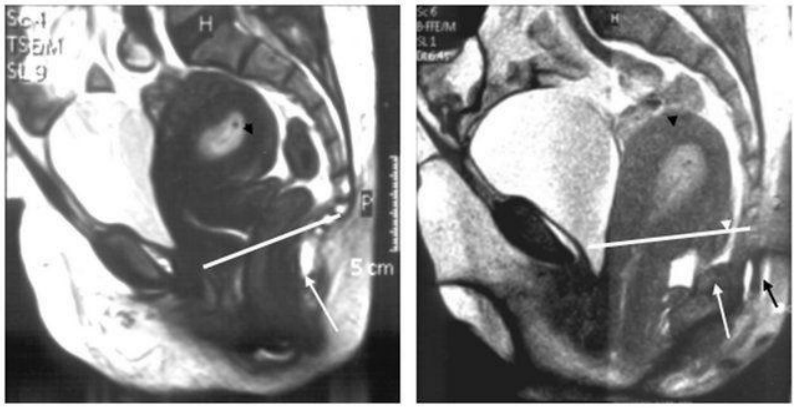
In MRI rectocele is usually seen as an anterior bulge in the contour of the rectum .Typically, a line drawn through the anterior wall of the anal canal is extended upward. When there is a bulge of rectum more than 2–3 cm anterior to this line is described as a rectocele.

A study shows that when we use rectal opacification is used while taking MRI, an accurate diagnosis of rectocele can made in 100% of patients when compared with findings intraoperatively.[14]



Enterocele

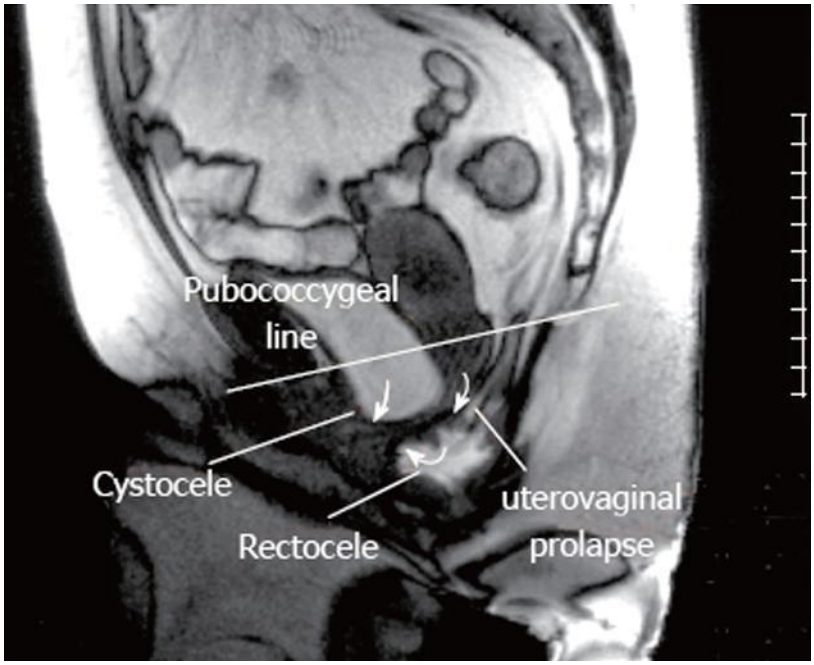
Clinical examination alone often cannot reliably differentiate an enterocele from a high rectocele. In the past, defecography was the only study that was used to help in the diagnosis of enteroceles. In MRI, small bowel or sigmoid prolapse can be identified between the rectum and vagina . There occurs widening of the superior portion of the rectovaginal septum with fat. These changes can be seen on images got when the patient is at rest. But a larger enterocele is apparent when the woman is straining.



In the above picture the two white arrows represent enteroceles on MRI.

Criteria which are used in the diagnosis of enterocele are:

- Bowel seen between the vagina and rectum.
- Bowel seen below the pubococcygeal line.
- When there is widening of the rectovaginal space.
- When there is abnormal deepening of the cul-de-sac.



Grading of hiatal enlargement, pelvic organ prolapse and pelvic floor descent using MRI.

Grade	Hiatal Enlargement	Pelvic Organ Prolapse	Pelvic Floor Descent
0	Less than 6 cm	Organ above H-line	0-2 cm
1	6-8 cm	0-2 cm below H-line	2-4 cm
2	8-10 cm	2-4 cm below H-line	4-6 cm
3	10 cm or more	4 cm or more below H-line	6 cm or more

AIM OF THE STUDY

- To study the role of MRI in diagnosis and management of patients with various pelvic floor dysfunctions including pelvic organ prolapse,urinary and defecation difficulties.

OBJECTIVES

- To study the changes in pelvic floor anatomy in women with pelvic floor dysfunctions.
- To study the effect of age and parity on pelvic floor anatomy in women with pelvic floor dysfunctions.
- To study the changes in pelvic floor anatomy after a course of pelvic floor exercises(kegel excercises).

MATERIALS AND METHODS

Ethical committee clearance obtained and enclosed.

STUDY DESIGN

Prospective observational study

INCLUSION CRITERIA

Patients attending Gynaec OPD KMCH with any one of the following :

1.I st and second degree UteroVaginal prolapse.

2.cystocele.

3.rectocele.

4.Enterocele.

5.defaecatory incontinence.

6.III degree prolapse .

EXCLUSION CRITERIA

1.Age under 18

2.Those with procidentia.

3.Pelvic masses.

4.Currently under treatment for malignancy.

5.Previous radiation to the pelvis

6.Any autoimmune disorder

7.Women who are currently pregnant

8.Pregnant in the past year.

9.Abnormal uterine bleeding.

Place of study

Gynaecology outpatient department in Kilpauk medical college

Period of study: September 2013 to September 2014

Sample Size: calculated by the formula

Sample Size for Frequency in a Population	
Population size(for finite population correction factor or fpc)(*N*):	2000
Hypothesized % frequency of outcome factor in the population (*p*):	5%+/-5
Confidence limits as % of 100(absolute +/- %)(*d*):	5%
Design effect (for cluster surveys-*DEFF*):	1

Sample Size(n) for Various Confidence Levels	
Confidence Level(%)	**Sample Size**
95%	71

Equation
Sample size n = **[DEFF*Np(1-p)]/ [(d^2/$Z^2_{1-\alpha/2}$*(N-1)+p*(1-p)]**

METHODS OF COLLECTION OF DATA AND STUDY

Women with complaints of mass descending per vaginum,urinary difficulty,defaecation difficulty or chronic pelvic pain(>6 months) attending Gynaec OPD KMCH after getting informed consent for the study were evaluated by

- Questionaire
- General examination
- Pelvic examination
- Basic investigations
- Dynamic T2 MRI of pelvic floor

The evaluation with MRI is done with the patient in the supine position, without injecting any contrast agent, and within 15 minutes. A multicoil array and a rapid half-Fourier T2-weighted imaging sequence are used to get sagittal images when the patient is at rest and during pelvic strain, followed by axial images. The H line, M line and levator plate angle are measured by the radiologist. Also the presence of cystocele,rectocele and enterocele are recorded and if present the type of cystocele is identified in MRI and in clinical examination. The patients

who were identified to be with pelvic floor dysfunctions of lower grade(I st and II nd degree prolapse) are subjected to pelvic floor excercises and followed up after a period of 6 months.Repeat MRI was taken and the anatomical changes in terms of H line,M line and levator plate angle are recorded.

METHOD OF ANALYSIS

Patients presenting to Gynaec OPD with symptoms of pelvic floor dysfunctions(already mentioned) are subjected to clinical examination and MRI.The changes in pelvic floor anatomy in each type of dysfunction is analysed in terms of H line(at rest and straining),M line(at rest and straining) and levator plate angle values. That is., the changes in levator hiatus dimension and descent of the pelvic organs in various degrees of prolapse are studied.

Substratified analysis is done and mean diameters in each degree of prolapse is identified(chi square tests using cross tables).The patients who are diagnosed to have cystocele (if present along with the type),rectocele or enterocele are also compared in both clinical examination and MRI and the degree of correlation is measured(inter rater kappa).The changes in pelvic floor anatomy in terms of H line, M line and levator plate angle with respect to age and parity is studied. In patients I st and II nd degree

prolapse the changes in anatomy in terms of H line, M line and levator plate angle are studied after a course of pelvic floor excercises(posthoc tests and paired t tests).The area under curve of ROC(Receiver operating curve) in each degree of prolapse is seen and the critical cut off value of the various anatomical parameters above which a patient develops a prolapse is calculated.

RESULTS AND OBSERVATION

Cross reference key to all tables used in Statistical Analysis:

Code	Description
Age Group 1	Ranges from Age 30 – 40
Age Group 2	Ranges from Age 40 – 50
Age Group 3	Ranges above Age 50
DOP	Degree of Prolapse
DOP value 0	No Prolapse
DOP Value 1	1st degree prolapse
DOP Value 2	2nd degree prolapse
DOP Value 3	3rd degree prolapse
Presenting Complaint 1	Mass descending PV
Presenting Complaint 2	Difficulty in urination
Presenting Complaint 3	Difficulty in Defecation
Presenting Complaint 4	Chronic Pelvic pain
Cystocele Value 0	No cystocele
Cystocele Value 1	Grade 1
Cystocele Value 2	Grade 2
Type of Cystocele Value 1	Central
Type of Cystocele Value 2	Transverse
Type of Cystocele Value 3	Paravaginal
Type of Cystocele Value 4	Equivocal
Rectocele Value 0	No Rectocele
Rectocele Value 1	Grade 1
Rectocele Value 2	Grade 2
Enterocele Value 0	No Enterocele
Enterocele Value 1	Enterocele Present
CE	Clinical Examination

Table 1

Cross table to show the distribution of various clinical degrees of prolapse in different age groups

			CE DOP				
			0	1	2	3	Total
AGE GROUP	1	Count	12	12	1	0	25
		% within AGE GROUP	48.0%	48.0%	4.0%	.0%	100.0%
		% within CE DOP	85.7%	70.6%	3.4%	.0%	27.8%
		% of Total	13.3%	13.3%	1.1%	.0%	27.8%
	2	Count	2	5	28	0	35
		% within AGE GROUP	5.7%	14.3%	80.0%	.0%	100.0%
		% within CE DOP	14.3%	29.4%	96.6%	.0%	38.9%
		% of Total	2.2%	5.6%	31.1%	.0%	38.9%
	3	Count	0	0	0	30	30
		% within AGE GROUP	.0%	.0%	.0%	100.0%	100.0%
		% within CE DOP	.0%	.0%	.0%	100.0%	33.3%
		% of Total	.0%	.0%	.0%	33.3%	33.3%
	Total	Count	14	17	29	30	90
		% within AGE GROUP	15.6%	18.9%	32.2%	33.3%	100.0%
		% within CE DOP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.6%	18.9%	32.2%	33.3%	100.0%

Chi Square Test:

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	141.680[a]	6	.000
Likelihood Ratio	155.296	6	.000
Linear-by-Linear Association	72.285	1	.000
N of Valid Cases	90		

a. 3 cells (25.0%) have expected count less than 5. The minimum expected count is 3.89.

Chi square= 141.680 P=0.000 <0.001

There exists a statistical significance among no prolapse and prolapse different degree patients with respect to age.

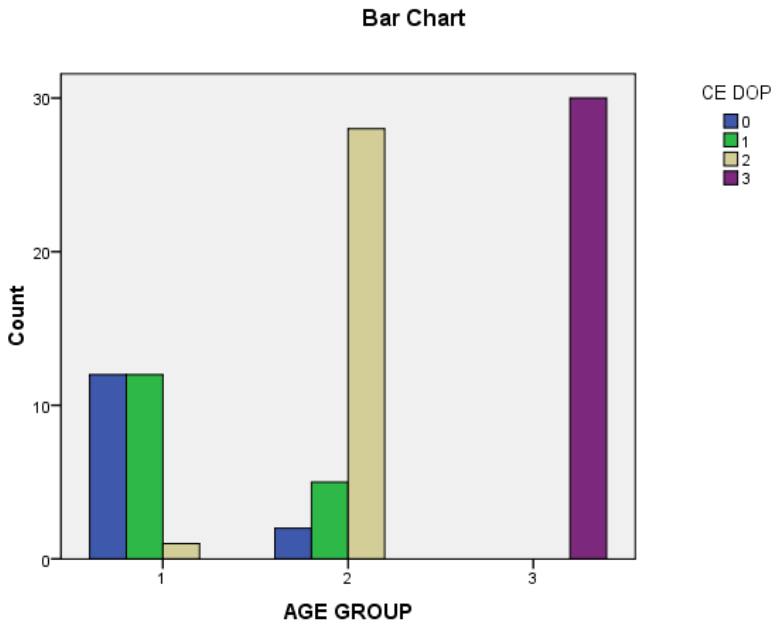


Table 2

Cross table showing distribution of various clinical degrees of prolapse in different parities

			CE DOP				
			0	1	2	3	Total
PARITY	2	Count	8	6	4	12	30
		% within PARITY	26.7%	20.0%	13.3%	40.0%	100.0%
		% within CE DOP	57.1%	35.3%	13.8%	40.0%	33.3%
		% of Total	8.9%	6.7%	4.4%	13.3%	33.3%
	3	Count	6	10	21	11	48
		% within PARITY	12.5%	20.8%	43.8%	22.9%	100.0%
		% within CE DOP	42.9%	58.8%	72.4%	36.7%	53.3%
		% of Total	6.7%	11.1%	23.3%	12.2%	53.3%
	4	Count	0	1	4	3	8
		% within PARITY	.0%	12.5%	50.0%	37.5%	100.0%
		% within CE DOP	.0%	5.9%	13.8%	10.0%	8.9%

		% of Total	.0%	1.1%	4.4%	3.3%	8.9%
	5	Count	0	0	0	3	3
		% within PARITY	.0%	.0%	.0%	100.0%	100.0%
		% within CE DOP	.0%	.0%	.0%	10.0%	3.3%
		% of Total	.0%	.0%	.0%	3.3%	3.3%
	6	Count	0	0	0	1	1
		% within PARITY	.0%	.0%	.0%	100.0%	100.0%
		% within CE DOP	.0%	.0%	.0%	3.3%	1.1%
		% of Total	.0%	.0%	.0%	1.1%	1.1%
	Total	Count	14	17	29	30	90
		% within PARITY	15.6%	18.9%	32.2%	33.3%	100.0%
		% within CE DOP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.6%	18.9%	32.2%	33.3%	100.0%

Chi-Square Tests

	Value	**Df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	20.292[a]	12	.062
Likelihood Ratio	22.748	12	.030
Linear-by-Linear Association	5.499	1	.019
N of Valid Cases	90		

a 13 cells (65.0%) have expected count less than 5. The minimum expected count is .16.

Chi square= 20.292 p= 0.062 not significant

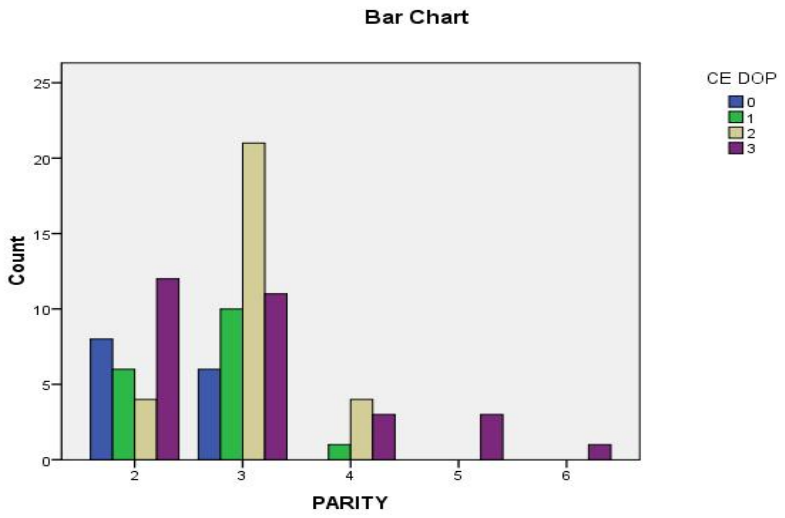


Table 3

Cross table showing distribution of various clinical degrees of prolapse based on presenting complaints

			CE DOP				
			0	1	2	3	Total
PRESENTING COMPLAINT	1	Count	5	16	24	30	75
		% within PRESENTING COMPLAINT	6.7%	21.3%	32.0%	40.0%	100.0%
		% within CE DOP	35.7%	94.1%	82.8%	100.0%	83.3%
		% of Total	5.6%	17.8%	26.7%	33.3%	83.3%
	2	Count	4	0	4	0	8
		% within PRESENTING COMPLAINT	50.0%	.0%	50.0%	.0%	100.0%
		% within CE DOP	28.6%	.0%	13.8%	.0%	8.9%
		% of Total	4.4%	.0%	4.4%	.0%	8.9%
	3	Count	2	1	0	0	3
		% within PRESENTING COMPLAINT	66.7%	33.3%	.0%	.0%	100.0%
		% within CE DOP	14.3%	5.9%	.0%	.0%	3.3%
		% of Total	2.2%	1.1%	.0%	.0%	3.3%
	4	Count	3	0	1	0	4

		% within PRESENTING COMPLAINT	75.0%	.0%	25.0%	.0%	100.0%
		% within CE DOP	21.4%	.0%	3.4%	.0%	4.4%
		% of Total	3.3%	.0%	1.1%	.0%	4.4%
	Total	Count	14	17	29	30	90
		% within PRESENTINGCOMPLAINT	15.6%	18.9%	32.2%	33.3%	100.0%
		% within CE DOP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.6%	18.9%	32.2%	33.3%	100.0%

Chi-Square Tests

	Value	Df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.688[a]	9	.000
Likelihood Ratio	34.772	9	.000
Linear-by-Linear Association	18.314	1	.000
N of Valid Cases	90		

a. 12 cells (75.0%) have expected count less than 5. The minimum expected count is .47.

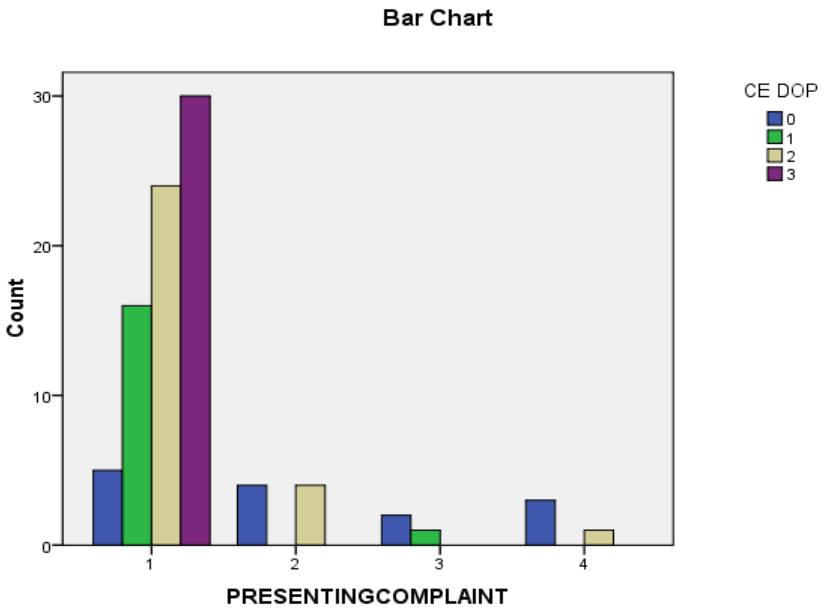


Table 4

Cross table showing the distribution of clinically diagnosed cystocele in various degrees of prolapse

			CE DOP				
			0	1	2	3	Total
CE CYSTO	0	Count	11	7	1	6	25
		% within CE CYSTO	44.0%	28.0%	4.0%	24.0%	100.0%
		% within CE DOP	78.6%	41.2%	3.4%	20.0%	27.8%
		% of Total	12.2%	7.8%	1.1%	6.7%	27.8%
	1	Count	2	9	11	0	22
		% within CE CYSTO	9.1%	40.9%	50.0%	.0%	100.0%
		% within CE DOP	14.3%	52.9%	37.9%	.0%	24.4%
		% of Total	2.2%	10.0%	12.2%	.0%	24.4%
	2	Count	1	1	17	24	43
		% within CE CYSTO	2.3%	2.3%	39.5%	55.8%	100.0%
		% within CE DOP	7.1%	5.9%	58.6%	80.0%	47.8%
		% of Total	1.1%	1.1%	18.9%	26.7%	47.8%
	Total	Count	14	17	29	30	90
		% within CE CYSTO	15.6%	18.9%	32.2%	33.3%	100.0%
		% within CE DOP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.6%	18.9%	32.2%	33.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	54.981[a]	6	.000
Likelihood Ratio	65.405	6	.000
Linear-by-Linear Association	30.376	1	.000
N of Valid Cases	90		

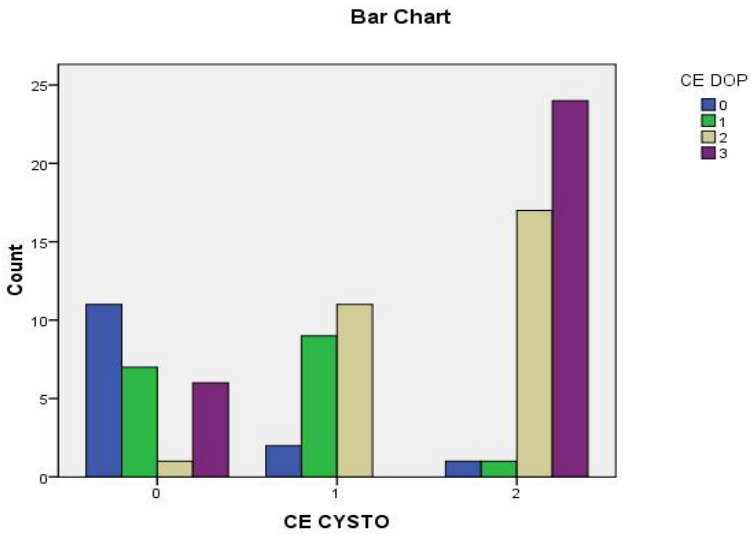


Table 5

Cross table showing distribution of clinical types of cystocele in various degrees of PROLAPSE

			CE DOP				
			0	**1**	**2**	**3**	**Total**
CE Type of cysto	0	Count	11	7	1	6	25
		% within CEType of cysto	44.0%	28.0%	4.0%	24.0%	100.0%
		% within CE DOP	78.6%	41.2%	3.4%	20.0%	27.8%
		% of Total	12.2%	7.8%	1.1%	6.7%	27.8%
	1	Count	2	7	24	12	45
		% within CEType of cysto	4.4%	15.6%	53.3%	26.7%	100.0%
		% within CE DOP	14.3%	41.2%	82.8%	40.0%	50.0%
		% of Total	2.2%	7.8%	26.7%	13.3%	50.0%
	2	Count	0	0	0	8	8
		% within CEType of cysto	.0%	.0%	.0%	100.0%	100.0%
		% within CE DOP	.0%	.0%	.0%	26.7%	8.9%
		% of Total	.0%	.0%	.0%	8.9%	8.9%
	3	Count	0	0	1	1	2
		% within CEType of cysto	.0%	.0%	50.0%	50.0%	100.0%
		% within CE DOP	.0%	.0%	3.4%	3.3%	2.2%
		% of Total	.0%	.0%	1.1%	1.1%	2.2%
	4	Count	1	3	3	3	10

		% within CEType of cysto	10.0%	30.0%	30.0%	30.0%	100.0%
		% within CE DOP	7.1%	17.6%	10.3%	10.0%	11.1%
		% of Total	1.1%	3.3%	3.3%	3.3%	11.1%
	Total	Count	14	17	29	30	90
		% within CEType of cysto	15.6%	18.9%	32.2%	33.3%	100.0%
		% within CE DOP	100.0%	100.0%	100.0 %	100.0%	100.0%
		% of Total	15.6%	18.9%	32.2%	33.3%	100.0%

Chi-Square Tests:

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	49.548[a]	12	.000
Likelihood Ratio	51.472	12	.000
Linear-by-Linear Association	6.168	1	.013
N of Valid Cases	90		

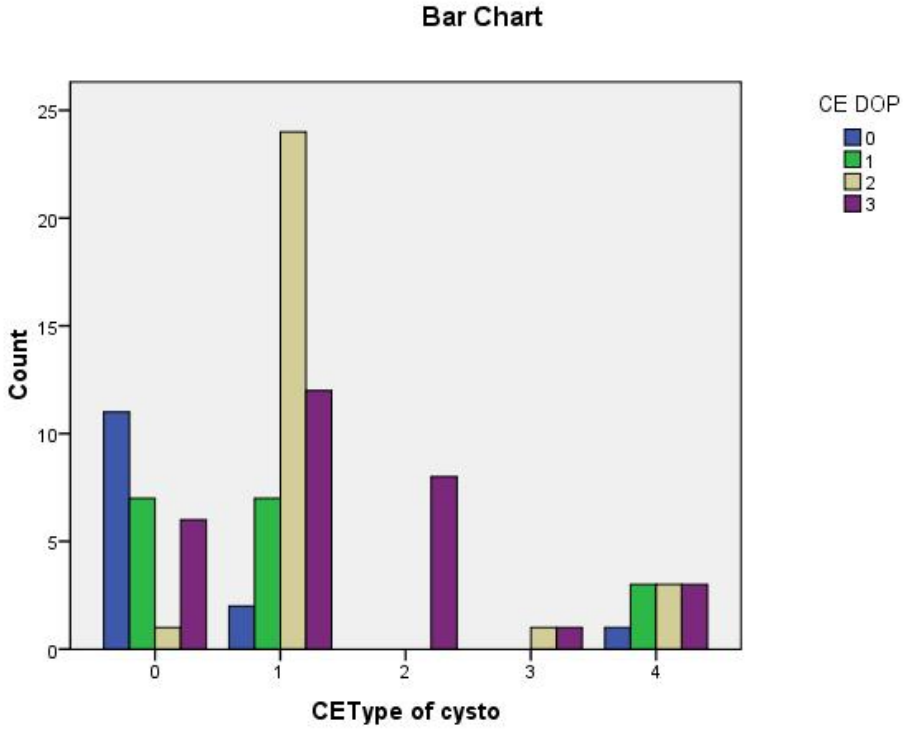


Table 6

Cross table showing distribution of clinical rectoceles in various degrees of prolapse

			CE DOP				
			0	1	2	3	Total
CERecto	0	Count	12	14	26	14	66
		% within CERecto	18.2%	21.2%	39.4%	21.2%	100.0%
		% within CE DOP	85.7%	82.4%	89.7%	48.3%	74.2%
		% of Total	13.5%	15.7%	29.2%	15.7%	74.2%
	1	Count	2	3	3	0	8
		% within CERecto	25.0%	37.5%	37.5%	.0%	100.0%
		% within CE DOP	14.3%	17.6%	10.3%	.0%	9.0%
		% of Total	2.2%	3.4%	3.4%	.0%	9.0%
	2	Count	0	0	0	15	15
		% within CERecto	.0%	.0%	.0%	100.0%	100.0%
		% within CE DOP	.0%	.0%	.0%	51.7%	16.9%
		% of Total	.0%	.0%	.0%	16.9%	16.9%
	Total	Count	14	17	29	29	89
		% within CERecto	15.7%	19.1%	32.6%	32.6%	100.0%
		% within CE DOP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.7%	19.1%	32.6%	32.6%	100.0%

Chi-Square Tests

	Value	**df**	**Asymp. Sig. (2-sided)**
Pearson Chi-Square	39.520[a]	6	.000
Likelihood Ratio	44.645	6	.000
Linear-by-Linear Association	15.259	1	.000
N of Valid Cases	89		

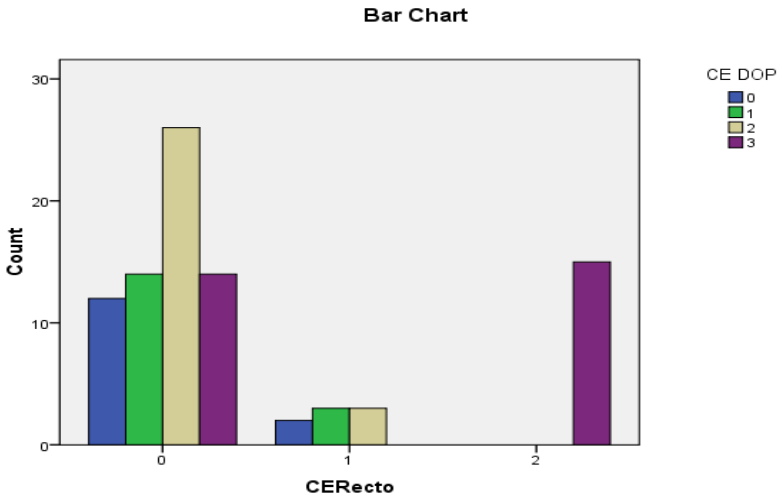


Table 7

Cross table showing distribution of clinically diagnosed enteroceles in various degrees of prolapse

			CE DOP				
			0	1	2	3	Total
CEEntero	0	Count	14	17	29	26	86
		% within CEEntero	16.3%	19.8%	33.7%	30.2%	100.0%
		% within CE DOP	100.0%	100.0%	100.0%	86.7%	95.6%
		% of Total	15.6%	18.9%	32.2%	28.9%	95.6%
	1	Count	0	0	0	4	4
		% within CEEntero	.0%	.0%	.0%	100.0%	100.0%
		% within CE DOP	.0%	.0%	.0%	13.3%	4.4%
		% of Total	.0%	.0%	.0%	4.4%	4.4%
	Total	Count	14	17	29	30	90
		% within CEEntero	15.6%	18.9%	32.2%	33.3%	100.0%
		% within CE DOP	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	15.6%	18.9%	32.2%	33.3%	100.0%

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	8.372[a]	3	.039
Likelihood Ratio	9.167	3	.027
Linear-by-Linear Association	5.046	1	.025
N of Valid Cases	90		

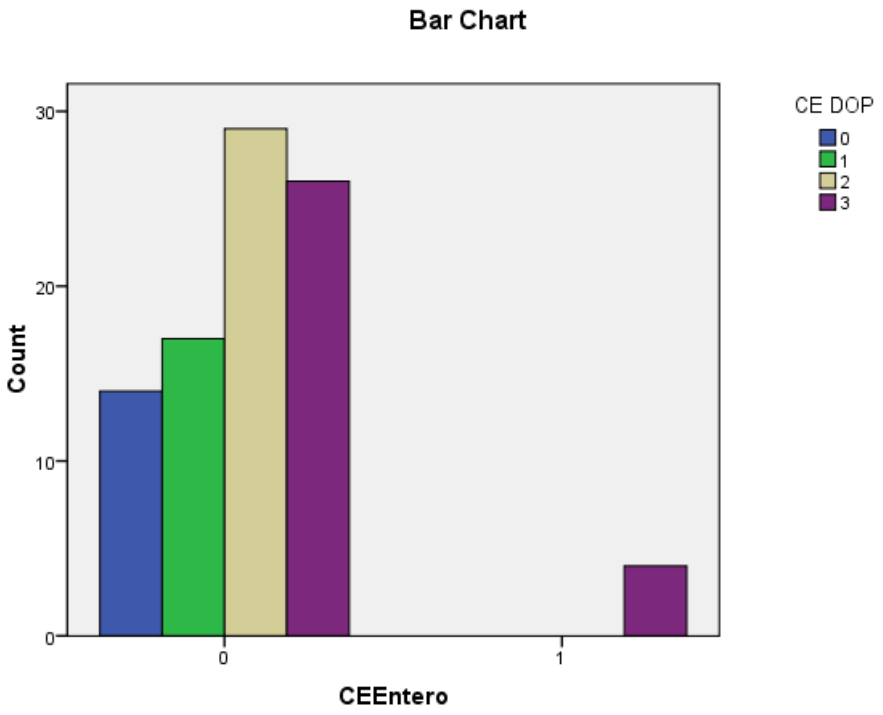


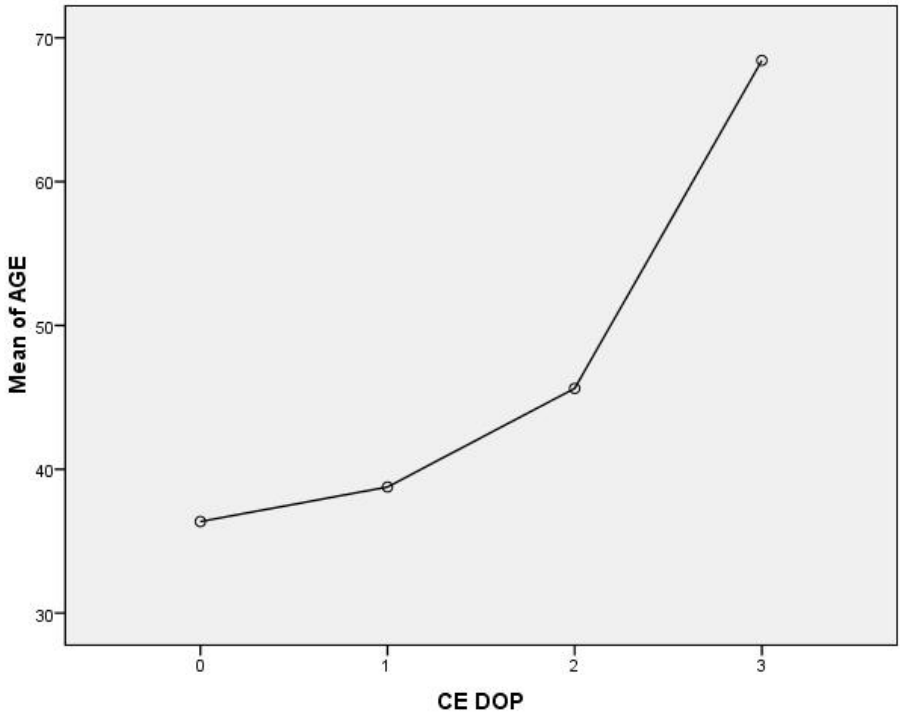
Table 8

Analysis of the variation in Degree of Prolapse with Age

Degree of Prolapse	Age				95% Confidence Interval for Mean	
	N	Mean	Std. Deviation	Std. Error	Lower Bound	Upper Bound
0	14	36.36	3.895	1.041	34.11	38.61
1	17	38.76	3.437	.834	37.00	40.53
2	29	45.62	2.638	.490	44.62	46.62
3	30	68.43	4.400	.803	66.79	70.08
Total	90	50.49	13.666	1.441	47.63	53.35

Degree of Prolapse	Age	
	Minimum	Maximum
0	30	45
1	33	44
2	40	50
3	58	80

Degree of Prolapse	Age	
	Minimum	Maximum
0	30	45
1	33	44
2	40	50
3	58	80
Total	30	80



ANOVA Test: Analysis of Variance

This is a collection of statistical models used to analyze the differences between the group means and their associated procedures like variations between and among groups.

AGE					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	15480.022	3	5160.007	388.423	.000
Within Groups	1142.467	86	13.285		
Total	16622.489	89			

Anova test : F= 388.423 p= 0.000<0.001.

There exists a statistical significance among the non prolapse and different degree prolapse patients with respect to Age distribution.

Means Plots

Descriptives					
		N	**Mean**	**Std. Deviation**	**Std. Error**
H line(at rest)	0	14	5.09	.121	.032
	1	17	5.28	.251	.061
	2	29	5.41	.227	.042
	3	30	9.36	.211	.039
	Total	90	6.65	1.940	.205
H LINE(STRAINING)	0	14	5.771	.4762	.1273
	1	17	6.318	.7804	.1893
	2	29	7.486	.3777	.0701
	3	30	9.973	.1596	.0291
	Total	90	7.828	1.6989	.1791
M LINE(at rest)	0	14	2.079	.1929	.0515
	1	17	2.218	.3395	.0824
	2	29	2.476	.2948	.0547
	3	30	4.690	.2734	.0499
	Total	90	3.103	1.1704	.1234
M LINE(STRAININ)	0	14	3.164	.8482	.2267
	1	17	3.835	.8838	.2144
	2	29	5.834	.2595	.0482
	3	30	7.807	.2016	.0368
	Total	90	5.699	1.8594	.1960

LEVATOR Plate Angle (in degrees)	0	14	46.971	1.9727	.5272
	1	17	47.671	1.0233	.2482
	2	29	50.210	.7957	.1478
	3	30	56.497	1.8709	.3416
	Total	90	51.322	4.1291	.4352

Descriptives					
		95% Confidence Interval for Mean			
		Lower Bound	**Upper Bound**	**Minimum**	**Maximum**
H line(at rest)	0	5.02	5.16	5	5
	1	5.15	5.41	5	6
	2	5.32	5.49	5	6
	3	9.28	9.44	9	10
	Total	6.24	7.06	5	10
H LINE(STRAINING)	0	5.496	6.046	5.0	6.6
	1	5.916	6.719	5.4	8.0
	2	7.343	7.630	6.7	8.0
	3	9.914	10.033	9.7	10.3
	Total	7.472	8.184	5.0	10.3
M LINE(at rest)	0	1.967	2.190	1.7	2.4
	1	2.043	2.392	1.5	3.1
	2	2.364	2.588	2.0	3.0
	3	4.588	4.792	4.1	5.1
	Total	2.858	3.348	1.5	5.1
M LINE(STRAININ)	0	2.675	3.654	1.7	4.8
	1	3.381	4.290	2.7	6.0
	2	5.736	5.933	5.1	6.2
	3	7.731	7.882	7.5	8.3
	Total	5.309	6.088	1.7	8.3
LEVATOR Plate Angle (in degrees)	0	45.832	48.110	44.0	50.0
	1	47.144	48.197	46.0	49.2
	2	49.908	50.513	48.0	52.0
	3	55.798	57.195	53.5	60.5
	Total	50.457	52.187	44.0	60.5

ANOVA – Analysis of Variance				
		Sum of Squares	**df**	**Mean Square**
H line(at rest)	Between Groups	331.154	3	110.385
	Within Groups	3.930	86	.046
	Total	335.085	89	
H LINE(STRAINING)	Between Groups	239.454	3	79.818
	Within Groups	17.426	86	.203
	Total	256.881	89	
M LINE(at rest)	Between Groups	114.981	3	38.327
	Within Groups	6.928	86	.081
	Total	121.909	89	
M LINE(STRAININ)	Between Groups	282.795	3	94.265
	Within Groups	24.915	86	.290
	Total	307.710	89	
LEVATOR Plate Angle (in degrees)	Between Groups	1330.795	3	443.598
	Within Groups	186.580	86	2.170
	Total	1517.376	89	

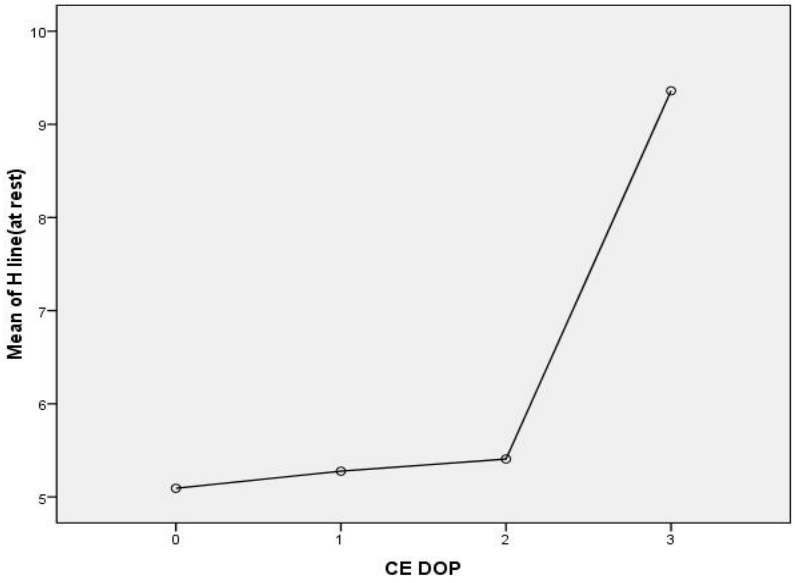
ANOVA			
		F	Sig.
H line(at rest)	Between Groups	2415.241	.000
H LINE(STRAINING)	Between Groups	393.905	.000
M LINE(at rest)	Between Groups	475.740	.000
M LINE(STRAININ)	Between Groups	325.376	.000
LEVATOR Plate Angle (in degrees)	Between Groups	204.467	.000

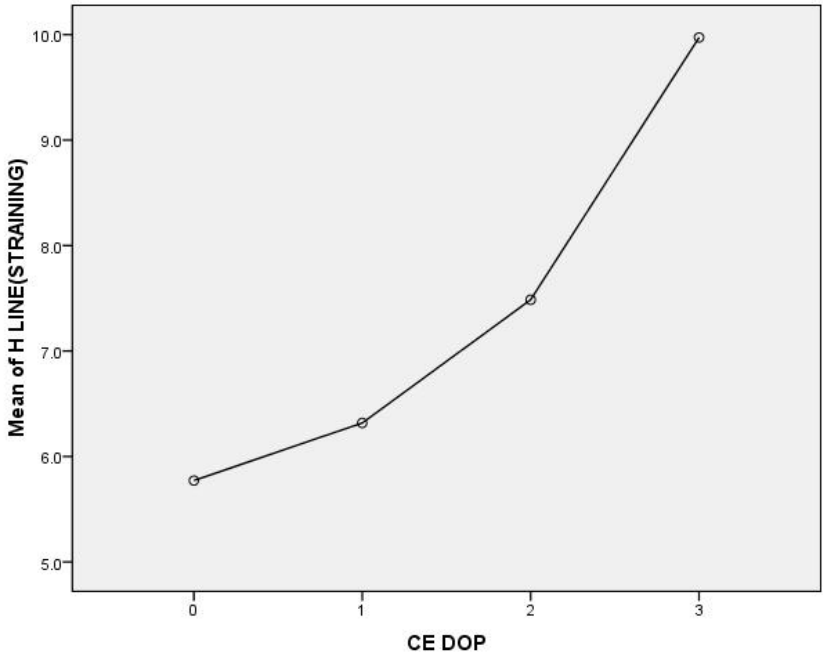
Post Hoc Tests

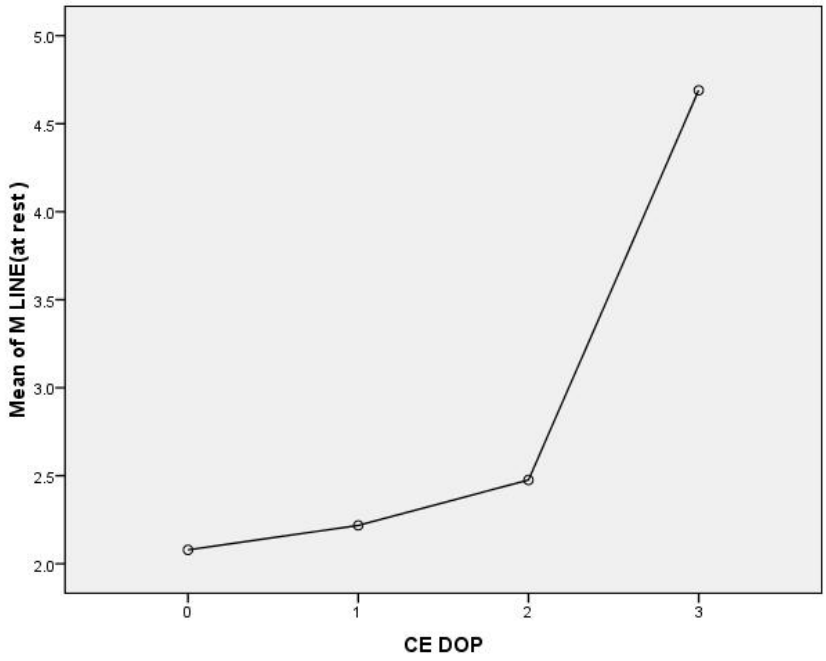
Multiple Comparisons							
LSD							
						95% Confidence Interval	
Dependent Variable	(I) CE DOP	(J) CE DOP	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
H line(at rest)	0	1	-.184*	.077	.020	-.34	-.03
		2	-.314*	.070	.000	-.45	-.18
		3	-4.267*	.069	.000	-4.40	-4.13
	1	0	.184*	.077	.020	.03	.34
		2	-.130*	.065	.049	-.26	.00
		3	-4.084*	.065	.000	-4.21	-3.95
	2	0	.314*	.070	.000	.18	.45
		1	.130*	.065	.049	.00	.26
		3	-3.953*	.056	.000	-4.06	-3.84
	3	0	4.267*	.069	.000	4.13	4.40
		1	4.084*	.065	.000	3.95	4.21
		2	3.953*	.056	.000	3.84	4.06
H LINE(STRAINING)	0	1	-.5462*	.1625	.001	-.869	-.223
		2	-1.7148*	.1465	.000	-2.006	-1.424
		3	-4.2019*	.1457	.000	-4.492	-3.912
	1	0	.5462*	.1625	.001	.223	.869
		2	-1.1686*	.1375	.000	-1.442	-.895
		3	-3.6557*	.1367	.000	-3.927	-3.384
	2	0	1.7148*	.1465	.000	1.424	2.006
		1	1.1686*	.1375	.000	.895	1.442
		3	-2.4871*	.1172	.000	-2.720	-2.254
	3	0	4.2019*	.1457	.000	3.912	4.492
		1	3.6557*	.1367	.000	3.384	3.927
		2	2.4871*	.1172	.000	2.254	2.720
M LINE(at rest)	0	1	-.1391	.1024	.178	-.343	.065
		2	-.3973*	.0924	.000	-.581	-.214
		3	-2.6114*	.0919	.000	-2.794	-2.429
	1	0	.1391	.1024	.178	-.065	.343
		2	-.2582*	.0867	.004	-.431	-.086
		3	-2.4724*	.0862	.000	-2.644	-2.301
	2	0	.3973*	.0924	.000	.214	.581
		1	.2582*	.0867	.004	.086	.431
		3	-2.2141*	.0739	.000	-2.361	-2.067
	3	0	2.6114*	.0919	.000	2.429	2.794

		1	2.4724*	.0862	.000	2.301	2.644
		2	2.2141*	.0739	.000	2.067	2.361
M LINE(STRAININ)	0	1	-.6710*	.1943	.001	-1.057	-.285
		2	-2.6702*	.1752	.000	-3.018	-2.322
		3	-4.6424*	.1742	.000	-4.989	-4.296
	1	0	.6710*	.1943	.001	.285	1.057
		2	-1.9992*	.1644	.000	-2.326	-1.672
		3	-3.9714*	.1634	.000	-4.296	-3.647
	2	0	2.6702*	.1752	.000	2.322	3.018
		1	1.9992*	.1644	.000	1.672	2.326
		3	-1.9722*	.1402	.000	-2.251	-1.694
	3	0	4.6424*	.1742	.000	4.296	4.989
		1	3.9714*	.1634	.000	3.647	4.296
		2	1.9722*	.1402	.000	1.694	2.251
LEVATOR Plate Angle (in degrees)	0	1	-.6992	.5316	.192	-1.756	.358
		2	-3.2389*	.4794	.000	-4.192	-2.286
		3	-9.5252*	.4767	.000	-10.473	-8.578
	1	0	.6992	.5316	.192	-.358	1.756
		2	-2.5398*	.4499	.000	-3.434	-1.645
		3	-8.8261*	.4471	.000	-9.715	-7.937
	2	0	3.2389*	.4794	.000	2.286	4.192
		1	2.5398*	.4499	.000	1.645	3.434
		3	-6.2863*	.3836	.000	-7.049	-5.524
	3	0	9.5252*	.4767	.000	8.578	10.473
		1	8.8261*	.4471	.000	7.937	9.715
		2	6.2863*	.3836	.000	5.524	7.049
*. The mean difference is significant at the 0.05 level.							

Means Plots


Mean of H line(at rest)
10
9
8
7
6
5
0
1
2
3
CE DOP


Mean of H LINE(STRAINING)
10.0
9.0
8.0
7.0
6.0
5.0
0
1
2
3
CE DOP


Mean of M LINE(at rest)
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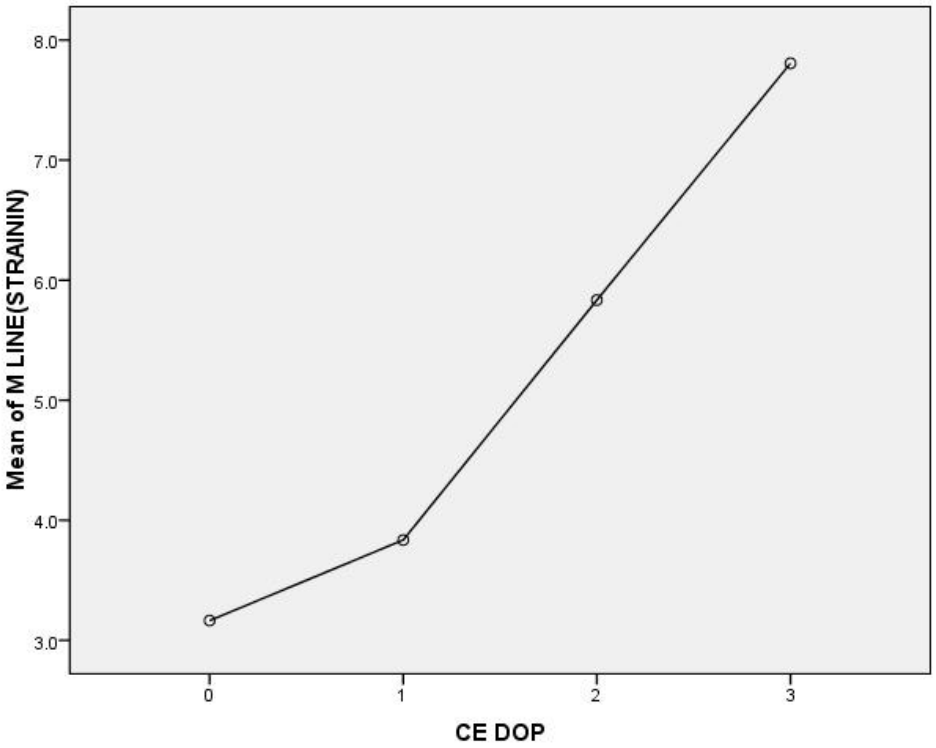
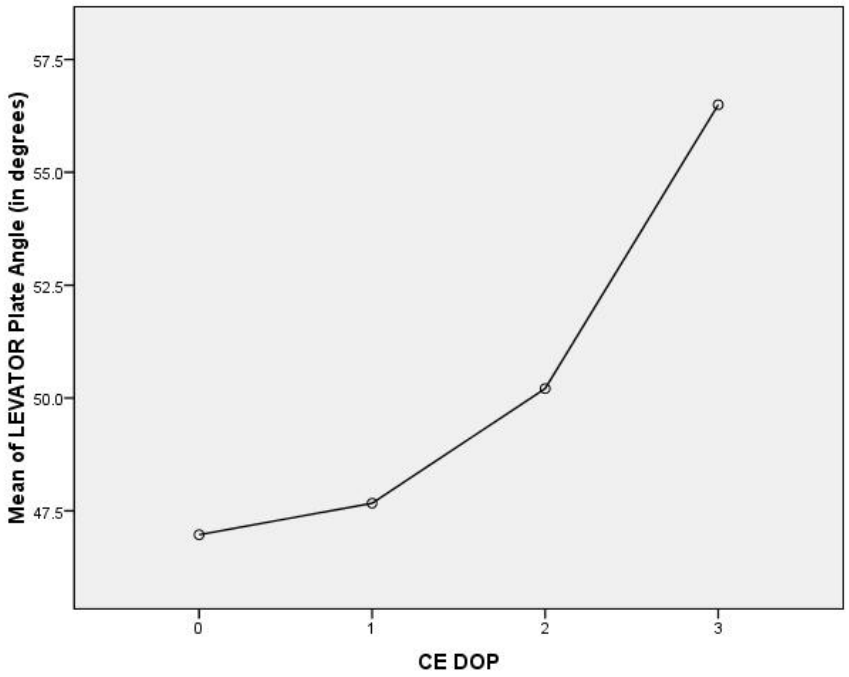
4.0
3.5
3.0
2.5
2.0
0
1
2
3
CE DOP


Mean of M LINE(STRAININ)
8.0
7.0
6.0
5.0
4.0
3.0
0
1
2
3
CE DOP



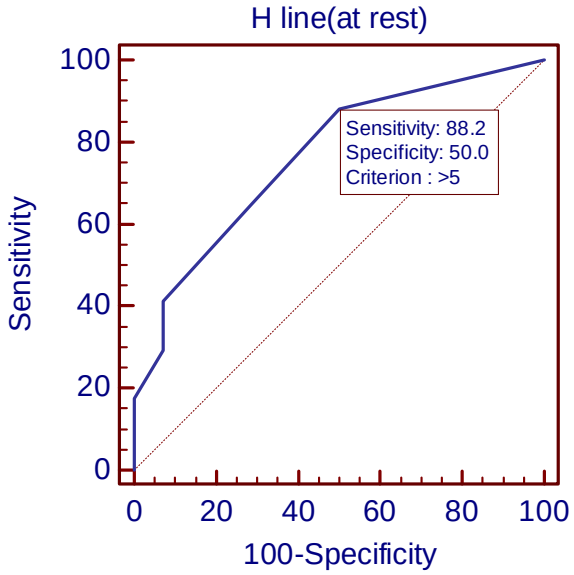
Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	H line(at rest)	5.30	58	.250	.033
	H LINE AFTER TREATMENT AT REST	5.29	58	.251	.033
Pair 2	H LINE(STRAINING)	6.805	58	.8845	.1161
	H LINE STRAININ	6.814	58	.9164	.1203
Pair 3	M LINE(at rest)	2.317	58	.3336	.0438
	M LINE(at rest)	2.193	58	.3593	.0472
Pair 4	M LINE(STRAININ)	4.733	58	1.2786	.1679
	M LINE(STRAININ)	4.231	58	1.6910	.2220
Pair 5	LEVATOR Plate Angle (in degrees)	48.979	57	1.5985	.2117
	LEVATOR Plate Angle (in degrees)	47.704	57	2.2487	.2979

Paired Samples Correlations				
		N	Correlation	Sig.
Pair 1	H line(at rest) & H LINE AFTER TREATMENT AT REST	58	.993	.000
Pair 2	H LINE(STRAINING) & H LINE STRAININ	58	.967	.000
Pair 3	M LINE(at rest) & M LINE(at rest)	58	.923	.000
Pair 4	M LINE(STRAININ) & M LINE(STRAININ)	58	.963	.000
Pair 5	LEVATOR Plate Angle (in degrees) & LEVATOR Plate Angle (in degrees)	57	.898	.000

Paired Samples Test				
		Paired Differences		
		Mean	Std. Deviation	Std. Error Mean
Pair 1	H line(at rest) - H LINE AFTER TREATMENT AT REST	.005	.029	.004
Pair 2	H LINE(STRAINING) - H LINE STRAININ	-.0086	.2319	.0305
Pair 3	M LINE(at rest) - M LINE(at rest)	.1241	.1380	.0181
Pair 4	M LINE(STRAININ) - M LINE(STRAININ)	.5017	.5729	.0752
Pair 5	LEVATOR Plate Angle (in degrees) - LEVATOR Plate Angle (in degrees)	1.2754	1.0763	.1426

Paired Samples Test			
		Paired Differences	
		95% Confidence Interval of the Difference	
		Lower	Upper
Pair 1	H line(at rest) - H LINE AFTER TREATMENT AT REST	-.002	.013
Pair 2	H LINE(STRAINING) - H LINE STRAININ	-.0696	.0524
Pair 3	M LINE(at rest) - M LINE(at rest)	.0878	.1604
Pair 4	M LINE(STRAININ) - M LINE(STRAININ)	.3511	.6524
Pair 5	LEVATOR Plate Angle (in degrees) - LEVATOR Plate Angle (in degrees)	.9899	1.5610

		t	df	Sig. (2-tailed)
Pair 1	H line(at rest) - H LINE AFTER TREATMENT AT REST	1.351	57	.182
Pair 2	H LINE(STRAINING) - H LINE STRAININ	-.283	57	.778
Pair 3	M LINE(at rest) - M LINE(at rest)	6.849	57	.000
Pair 4	M LINE(STRAININ) - M LINE(STRAININ)	6.669	57	.000
Pair 5	LEVATOR Plate Angle (in degrees) - LEVATOR Plate Angle (in degrees)	8.947	56	.000



ROC curve DEGREE 1 VS. NORMAL

Variable	H_line_at_rest_ H line(at rest)
Classification variable	CE_DOP CE DOP

Sample size		31
Positive group :	CE DOP = 1	17
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

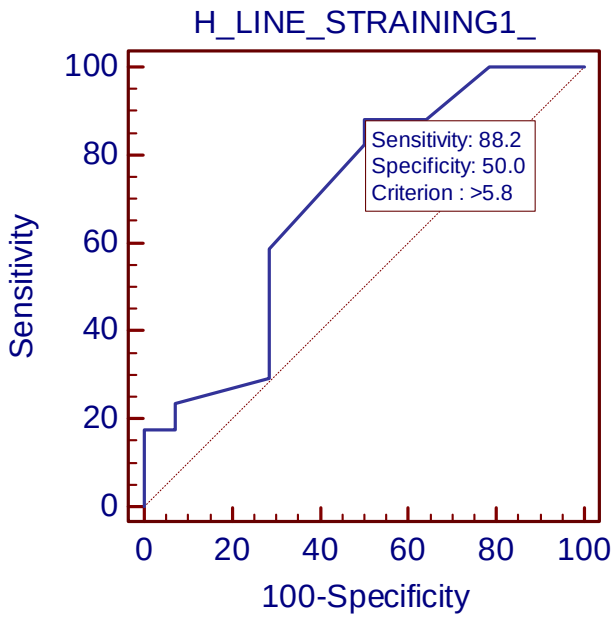
Area under the ROC curve (AUC)	0.764706
Standard Error[a]	0.0843
95% Confidence interval[b]	0.578588 to 0.897521
z statistic	3.139
Significance level P (Area=0.5)	0.0017

Youden index

Youden index J	0.3824
Associated criterion	>5

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥5	100.00	80.5 - 100.0	0.00	0.0 - 23.2	1.00	
>5	88.24	63.6 - 98.5	50.00	23.0 - 77.0	1.76	0.24
>5.1	64.71	38.3 - 85.8	71.43	41.9 - 91.6	2.26	0.49
>5.2	41.18	18.4 - 67.1	92.86	66.1 - 99.8	5.76	0.63
>5.3	29.41	10.3 - 56.0	92.86	66.1 - 99.8	4.12	0.76
>5.4	17.65	3.8 - 43.4	100.00	76.8 - 100.0		0.82
>6	0.00	0.0 - 19.5	100.00	76.8 - 100.0		1.00



ROC curve

Variable	H_LINE_STRAINING1_
Classification variable	CE_DOP CE DOP

Sample size		31
Positive group :	CE DOP = 1	17
Negative group :	CE DOP = 0	14

Disease prevalence (%)	unknown

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.695378
Standard Error[a]	0.0995

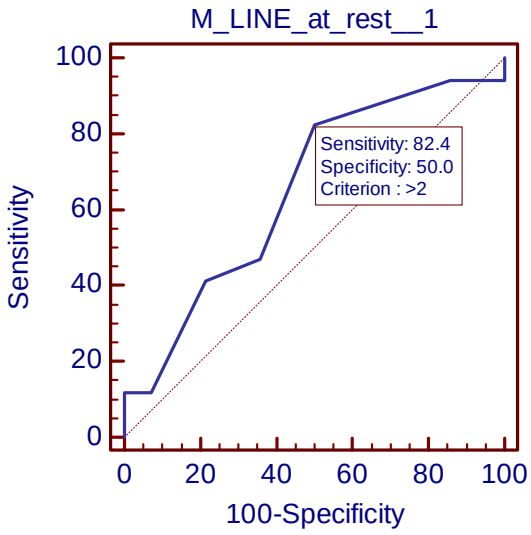
95% Confidence interval[b]	0.504746 to 0.846978
z statistic	1.964
Significance level P (Area=0.5)	0.0495

Youden index

Youden index J	0.3824
Associated criterion	>5.8

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥5	100.00	80.5 - 100.0	0.00	0.0 - 23.2	1.00	
>5.2	100.00	80.5 - 100.0	21.43	4.7 - 50.8	1.27	0.00
>5.4	88.24	63.6 - 98.5	35.71	12.8 - 64.9	1.37	0.33
>5.8	88.24	63.6 - 98.5	50.00	23.0 - 77.0	1.76	0.24
>5.9	82.35	56.6 - 96.2	50.00	23.0 - 77.0	1.65	0.35
>6	58.82	32.9 - 81.6	71.43	41.9 - 91.6	2.06	0.58
>6.1	29.41	10.3 - 56.0	71.43	41.9 - 91.6	1.03	0.99
>6.2	23.53	6.8 - 49.9	92.86	66.1 - 99.8	3.29	0.82
>6.4	17.65	3.8 - 43.4	92.86	66.1 - 99.8	2.47	0.89
>6.6	17.65	3.8 - 43.4	100.00	76.8 - 100.0		0.82
>8	0.00	0.0 - 19.5	100.00	76.8 - 100.0		1.00



ROC curve

Variable	M_LINE_at_rest__1
Classification variable	CE_DOP CE DOP

Sample size		31
Positive group :	CE DOP = 1	17
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.651261
Standard Error[a]	0.101
95% Confidence interval[b]	0.459796 to 0.812605
z statistic	1.493
Significance level P (Area=0.5)	0.1356

Youden index

Youden index J	0.3235
Associated criterion	>2

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥1.5	100.00	80.5 - 100.0	0.00	0.0 - 23.2	1.00	
>1.5	94.12	71.3 - 99.9	0.00	0.0 - 23.2	0.94	
>1.8	94.12	71.3 - 99.9	14.29	1.8 - 42.8	1.10	0.41
>2	82.35	56.6 - 96.2	50.00	23.0 - 77.0	1.65	0.35
>2.1	47.06	23.0 - 72.2	64.29	35.1 - 87.2	1.32	0.82
>2.2	41.18	18.4 - 67.1	78.57	49.2 - 95.3	1.92	0.75
>2.3	11.76	1.5 - 36.4	92.86	66.1 - 99.8	1.65	0.95
>2.4	11.76	1.5 - 36.4	100.00	76.8 - 100.0		0.88
>3.1	0.00	0.0 - 19.5	100.00	76.8 - 100.0		1.00

ROC curve

Variable	M_LINE_STRAININ_1
Classification variable	CE_DOP CE DOP

Sample size		31
Positive group :	CE DOP = 1	17
Negative group :	CE DOP = 0	14

Disease prevalence (%)	unknown

Area under the ROC curve (AUC)

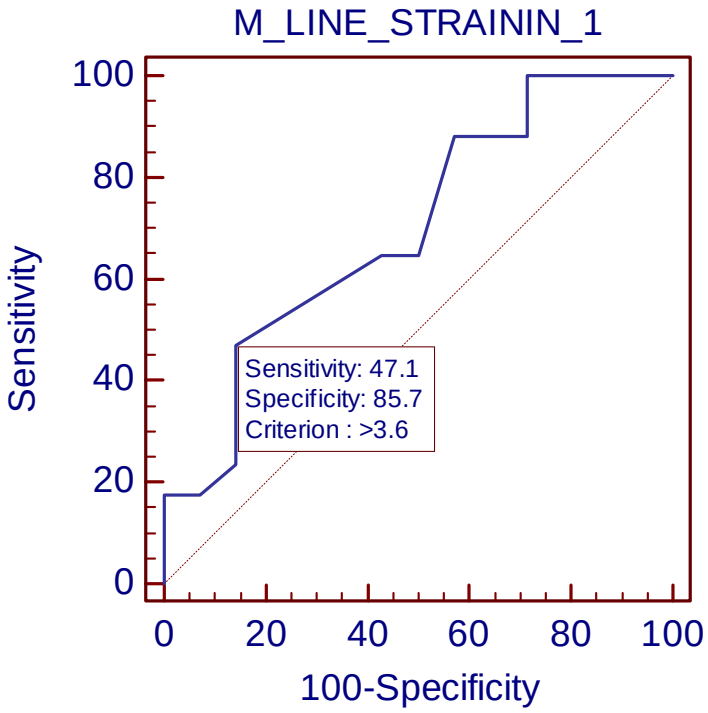
Area under the ROC curve (AUC)	0.699580
Standard Error[a]	0.0961
95% Confidence interval[b]	0.509105 to 0.850168
z statistic	2.076
Significance level P (Area=0.5)	0.0379

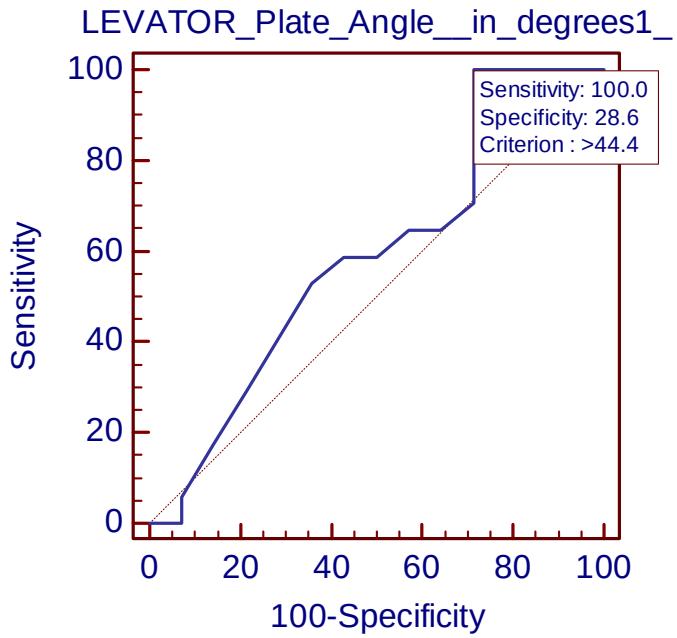
Youden index

Youden index J	0.3277
Associated criterion	>3.6

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥1.7	100.00	80.5 - 100.0	0.00	0.0 - 23.2	1.00	
>2.4	100.00	80.5 - 100.0	28.57	8.4 - 58.1	1.40	0.00
>2.9	88.24	63.6 - 98.5	28.57	8.4 - 58.1	1.24	0.41
>3.1	88.24	63.6 - 98.5	42.86	17.7 - 71.1	1.54	0.27
>3.2	64.71	38.3 - 85.8	50.00	23.0 - 77.0	1.29	0.71
>3.3	64.71	38.3 - 85.8	57.14	28.9 - 82.3	1.51	0.62
>3.6	47.06	23.0 - 72.2	85.71	57.2 - 98.2	3.29	0.62
>4	23.53	6.8 - 49.9	85.71	57.2 - 98.2	1.65	0.89
>4.1	17.65	3.8 - 43.4	92.86	66.1 - 99.8	2.47	0.89
>4.8	17.65	3.8 - 43.4	100.00	76.8 - 100.0		0.82
>6	0.00	0.0 - 19.5	100.00	76.8 - 100.0		1.00





ROC curve

Variable	LEVATOR_Plate_Angle__in_degrees1_
Classification variable	CE_DOP CE DOP

Sample size		31
Positive group :	CE DOP = 1	17
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

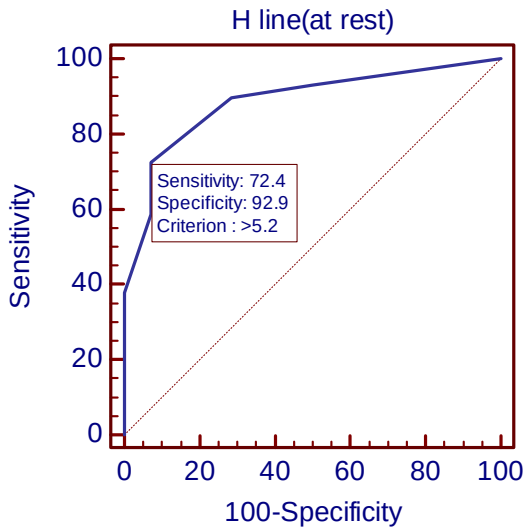
Area under the ROC curve (AUC)	0.590336
Standard Error[a]	0.108
95% Confidence interval[b]	0.400032 to 0.762704
z statistic	0.836
Significance level P (Area=0.5)	0.4033

Youden index

Youden index J	0.2857
Associated criterion	>44.4

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥44	100.00	80.5 - 100.0	0.00	0.0 - 23.2	1.00	
>44.4	100.00	80.5 - 100.0	28.57	8.4 - 58.1	1.40	0.00
>47	70.59	44.0 - 89.7	28.57	8.4 - 58.1	0.99	1.03
>47.1	64.71	38.3 - 85.8	35.71	12.8 - 64.9	1.01	0.99
>47.2	64.71	38.3 - 85.8	42.86	17.7 - 71.1	1.13	0.82
>47.6	58.82	32.9 - 81.6	50.00	23.0 - 77.0	1.18	0.82
>47.8	58.82	32.9 - 81.6	57.14	28.9 - 82.3	1.37	0.72
>47.9	52.94	27.8 - 77.0	64.29	35.1 - 87.2	1.48	0.73
>48	29.41	10.3 - 56.0	78.57	49.2 - 95.3	1.37	0.90
>48.3	17.65	3.8 - 43.4	85.71	57.2 - 98.2	1.24	0.96
>49	5.88	0.1 - 28.7	92.86	66.1 - 99.8	0.82	1.01
>49.2	0.00	0.0 - 19.5	92.86	66.1 - 99.8	0.00	1.08
>50	0.00	0.0 - 19.5	100.00	76.8 - 100.0		1.00



ROC curve

Variable	H_line_at_rest_ H line(at rest)
Classification variable	CE_DOP CE DOP

Sample size		43
Positive group :	CE DOP = 1	29
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.886700
Standard Error[a]	0.0509

95% Confidence interval[b]	0.752883 to 0.962876
z statistic	7.596
Significance level P (Area=0.5)	<0.0001

Youden index

Youden index J	0.6527
Associated criterion	>5.2

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥5	100.00	88.1 - 100.0	0.00	0.0 - 23.2	1.00	
>5	93.10	77.2 - 99.2	50.00	23.0 - 77.0	1.86	0.14
>5.1	89.66	72.6 - 97.8	71.43	41.9 - 91.6	3.14	0.14
>5.2	72.41	52.8 - 87.3	92.86	66.1 - 99.8	10.14	0.30
>5.3	58.62	38.9 - 76.5	92.86	66.1 - 99.8	8.21	0.45
>5.4	37.93	20.7 - 57.7	100.00	76.8 - 100.0		0.62
>5.8	0.00	0.0 - 11.9	100.00	76.8 - 100.0		1.00

ROC curve

Variable	H_LINE_STRAINING_ H LINE(STRAINING)
Classification variable	CE_DOP CE DOP

Sample size		43
Positive group :	CE DOP = 1	29
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

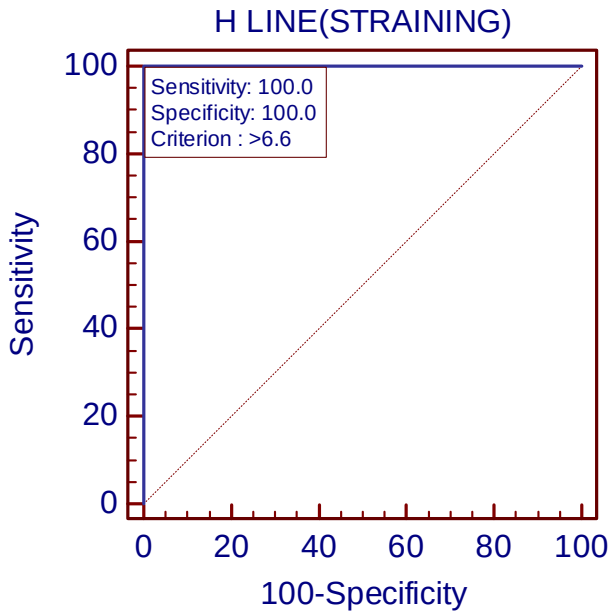
Area under the ROC curve (AUC)	1.000000
Standard Error[a]	0.000
95% Confidence interval[b]	0.917789 to 1.000000
Significance level P (Area=0.5)	<0.0001

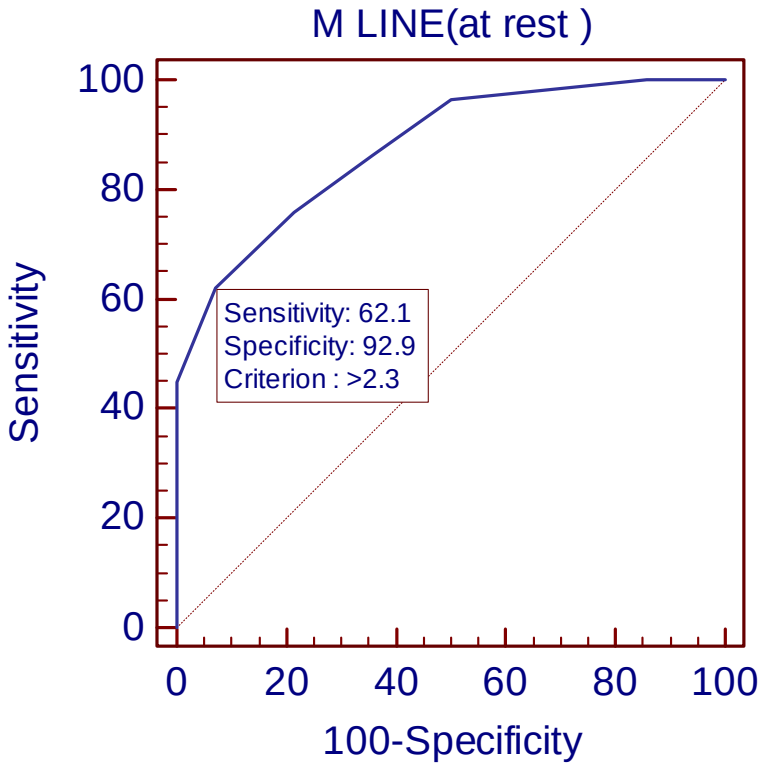
Youden index

Youden index J	1.0000
Associated criterion	>6.6

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥5	100.00	88.1 - 100.0	0.00	0.0 - 23.2	1.00	
>6.6	100.00	88.1 - 100.0	100.00	76.8 - 100.0		0.00
>8	0.00	0.0 - 11.9	100.00	76.8 - 100.0		1.00





ROC curve

Variable	M_LINE_at_rest__ M LINE(at rest)
Classification variable	CE_DOP CE DOP

Sample size		43
Positive group :	CE DOP = 1	29
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.876847
Standard Error[a]	0.0518
95% Confidence interval[b]	0.740653 to 0.957085

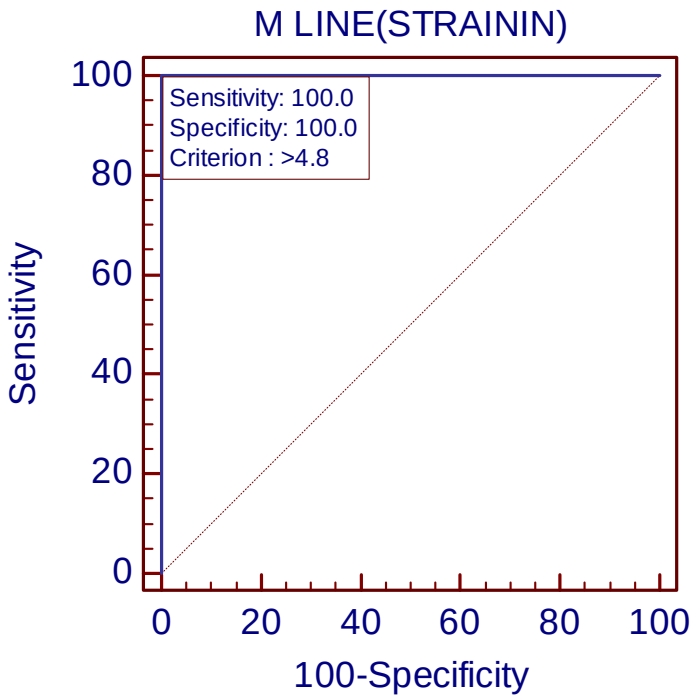
z statistic	7.277
Significance level P (Area=0.5)	<0.0001

Youden index

Youden index J	0.5493
Associated criterion	>2.3

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥1.7	100.00	88.1 - 100.0	0.00	0.0 - 23.2	1.00	
>1.8	100.00	88.1 - 100.0	14.29	1.8 - 42.8	1.17	0.00
>2	96.55	82.2 - 99.9	50.00	23.0 - 77.0	1.93	0.069
>2.1	86.21	68.3 - 96.1	64.29	35.1 - 87.2	2.41	0.21
>2.2	75.86	56.5 - 89.7	78.57	49.2 - 95.3	3.54	0.31
>2.3	62.07	42.3 - 79.3	92.86	66.1 - 99.8	8.69	0.41
>2.4	44.83	26.4 - 64.3	100.00	76.8 - 100.0		0.55
>3	0.00	0.0 - 11.9	100.00	76.8 - 100.0		1.00



ROC curve

Variable	M_LINE_STRAININ_ M LINE(STRAININ)
Classification variable	CE_DOP CE DOP

Sample size		43
Positive group :	CE DOP = 1	29
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	1.000000
Standard Error[a]	0.000
95% Confidence interval[b]	0.917789 to 1.000000

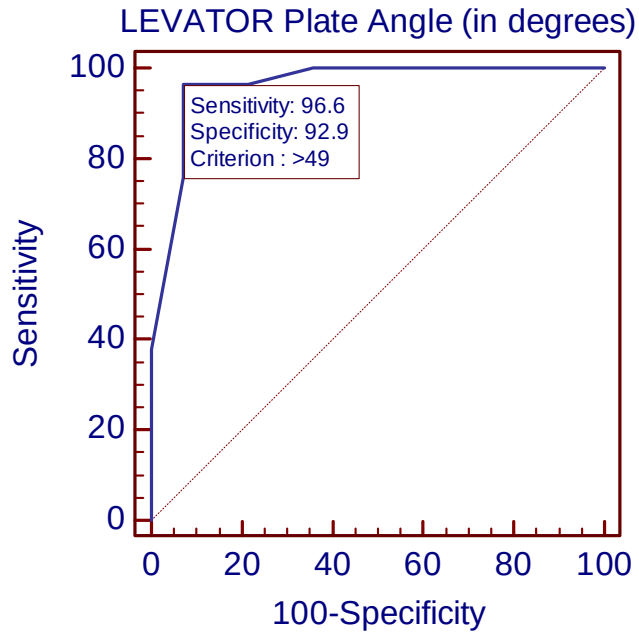
Significance level P (Area=0.5)	<0.0001

Youden index

Youden index J	1.0000
Associated criterion	>4.8

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥1.7	100.00	88.1 - 100.0	0.00	0.0 - 23.2	1.00	
>4.8	100.00	88.1 - 100.0	100.00	76.8 - 100.0		0.00
>6.2	0.00	0.0 - 11.9	100.00	76.8 - 100.0		1.00



ROC curve

Variable	LEVATOR_Plate_Angle__in_degrees_ LEVATOR Plate Angle (in degrees)
Classification variable	CE_DOP CE DOP
Sample size	43

Positive group :	CE DOP = 1	29
Negative group :	CE DOP = 0	14

Area under the ROC curve (AUC)

Area under the ROC curve (AUC)	0.961823
Standard Error[a]	0.0321
95% Confidence interval[b]	0.854118 to 0.996695
z statistic	14.400
Significance level P (Area=0.5)	<0.0001

Youden index

Youden index J	0.8941
Associated criterion	>49

Criterion values and coordinates of the ROC curve

Criterion	Sensitivity	95% CI	Specificity	95% CI	+LR	-LR
≥44	100.00	88.1 - 100.0	0.00	0.0 - 23.2	1.00	
>47.9	100.00	88.1 - 100.0	64.29	35.1 - 87.2	2.80	0.00
>48	96.55	82.2 - 99.9	78.57	49.2 - 95.3	4.51	0.044
>49	96.55	82.2 - 99.9	92.86	66.1 - 99.8	13.52	0.037
>49.5	75.86	56.5 - 89.7	92.86	66.1 - 99.8	10.62	0.26
>50	37.93	20.7 - 57.7	100.00	76.8 - 100.0		0.62
>52	0.00	0.0 - 11.9	100.00	76.8 - 100.0		1.00

COMPARISON OF CLINICAL EXAMINATION AND MRI

Results

Diagnostic or Screening Test Evaluation 1

- Degree of Prolapse

Single Table Analysis			
	Positive	Negative	Total
Positive	76	5	81
Negative	0	9	9
	76	14	90

Parameter	Estimate	Lower - Upper 95% CIs	Method
Sensitivity	100%	(95.19, 100[1])	Wilson Score
Specificity	64.29%	(38.76, 83.66[1])	Wilson Score
Positive Predictive Value	93.83%	(86.35, 97.33[1])	Wilson Score
Negative Predictive Value	100%	(70.08, 100[1])	Wilson Score
Diagnostic Accuracy	94.44%	(87.65, 97.6[1])	Wilson Score

Frequency table & Chi-square test

Codes X	CE_DOP CE DOP
Codes Y	MRIDOP

	Codes X				
Codes Y	0	1	2	3	
0	9	0	0	0	9 (10.0%)
1	5	15	0	0	20 (22.2%)
2	0	2	29	0	31 (34.4%)
3	0	0	0	30	30 (33.3%)
	14 (15.6%)	17 (18.9%)	29 (32.2%)	30 (33.3%)	90

Inter-rater agreement

Data	Class 1	Class 2
Class 1	76	5
Class 2	0	9

Options

Weighted Kappa	Linear weights

Results

Weighted Kappa	0.752
Standard error	0.104
95% CI	0.548 to 0.957

It has been observed that out of total 14 cases, 5 cases have been identified to have 1st degree of Prolapse in MRI while CE DOP was identified to be 0.

Diagnostic or Screening Test 2 - CYSTOCELE MRI

Data

CE CYSTO	**Disease Present**	**Disease Absent**	
Test Positive	64	1	65
Test Negative	5	20	25
	69	21	

Results

Sensitivity	92.75%	83.89% to 97.61%
Specificity	95.24%	76.18% to 99.88%
Positive Likelihood Ratio	19.48	2.87 to 132.05
Negative Likelihood Ratio	0.08	0.03 to 0.18
Disease prevalence	76.67%	66.57% to 84.94%
Positive Predictive Value	98.46%	91.72% to 99.96%
Negative Predictive Value	80.00%	59.30% to 93.17%

McNemar test (paired proportions)

Data

	Pos.	Neg.	
Pos.	61	1	71.3%
Neg.	5	20	28.7%
	75.9%	24.1%	

Results

Difference	4.60%
95% CI	-1.95% to 6.84%
Exact probability	P = 0.2188

Diagnostic or Screening Test 3 - CE ENTEROCELE MRI ENTEROCELE

Data

Results

Sensitivity	80.00%	28.36% to 99.49%
Specificity	100.00%	95.75% to 100.00%
Positive Likelihood Ratio		
Negative Likelihood Ratio	0.20	0.03 to 1.15
Disease prevalence	5.56%	1.83% to 12.49%
Positive Predictive Value	100.00%	39.76% to 100.00%
Negative Predictive Value	98.84%	93.69% to 99.97%

McNemar test (paired proportions)ata

	Pos.	Neg.	
Pos.	4	0	4.4%
Neg.	1	85	95.6%
	5.6%	94.4%	

Results

Difference	1.11%
95% CI	-1.06% to 1.11%
Exact probability	P = 1.0000

Diagnostic or Screening Test 4 - RECTO CELE VS MRI RECTOCELE

Data

	Disease Present	Disease Absent	
Test Positive	21	2	23
Test Negative	4	62	66
	25	64	

Results

Sensitivity	84.00%	63.92% to 95.46%
Specificity	96.87%	89.16% to 99.62%
Positive Likelihood Ratio	26.88	6.80 to 106.29
Negative Likelihood Ratio	0.17	0.07 to 0.41
Disease prevalence	28.09%	19.07% to 38.62%
Positive Predictive Value	91.30%	71.96% to 98.93%
Negative Predictive Value	93.94%	85.20% to 98.32%

McNemar test (paired proportions)

Data

	Pos.	Neg.	
Pos.	21	2	25.8%
Neg.	4	62	74.2%
	28.1%	71.9%	

Results

Difference	2.25%	
95% CI	-3.74% to 6.16%	
Exact probability	P = 0.6875	

EFFECT OF AGE ON PELVIC FLOOR ANATOMY

	AGE GROUP	N	Mean	Std. Deviation
H line(at rest)	1	12	5.325	.2832
	2	5	5.160	.0894
H LINE(STRAINING)	1	12	6.28	.811
	2	5	6.40	.784
M LINE(at rest)	1	12	2.175	.3621
	2	5	2.320	.2864
M LINE(STRAININ)	1	12	3.71	.825
	2	5	4.14	1.043
LEVATOR Plate Angle (in degrees)	1	12	47.33	.987
	2	5	48.48	.589

EFFECT OF PARITY ON PELVIC FLOOR ANATOMY

		N	Mean	Std. Deviation
H line(at rest)	2	6	5.217	.1722
	3	10	5.300	.3018
	4	1	5.400	.
	Total	17	5.276	.2513
H LINE(STRAINING)	2	6	5.93	.273
	3	10	6.54	.942
	4	1	6.40	.
	Total	17	6.32	.780
M LINE(at rest)	2	6	2.167	.1211
	3	10	2.240	.4402
	4	1	2.300	.
	Total	17	2.218	.3395
M LINE(STRAININ)	2	6	3.32	.454
	3	10	4.13	.998
	4	1	4.00	.
	Total	17	3.84	.884
LEVATOR Plate Angle (in degrees)	2	6	47.42	1.303
	3	10	47.79	.921
	4	1	48.00	.
	Total	17	47.67	1.023

DISCUSSION

In this study the following are thus evident:

- With the area under curve interpretation of ROC(Receiver operating curve) with respect to clinical examination, with a sensitivity of around 90% it is found that levator hiatus width cut off at rest above 5 cm and at straining above 5.8 cm develop a clinical first degree prolapse clinically.
- M line straining with a sensitivity of 100% shows cut off more than 4.8 cm to develop a clinical prolapse.
- Similarly from ROC curve of various other MRI parameters, it is found that with almost 100% sensitivity with respect to clinical examination a levator plate angle of more than 44.4 degrees develop a clinical first degree prolapse.
- From ROC of degree II prolapse it is inferred that the cut off value of levator hiatus width at rest>5.2 cm at straining>6.6 cm descent>2.3 cm at rest and >4.8 cm at straining with specificity around 100%
- The cut off value for levator plate angle is >49 deg with sensitivity around 96% in clinical II degree prolapse.

- 5 patients of first degree prolapse who were not diagnosed clinically were picked up by MRI.
- In 7 patients with equivocal findings with regard to type of cystocele in clinical examination,MRI could identify the fascial defect and hence the type of cyctocele and thus helped in site specific repair of cystourethrocele.
- MRI has also helped to differentiate high rectoceles and enteroceles.
- Effect of age and parity on pelvic floor anatomy-With increasing age there is a increase in mean values of levator hiatus width at straining and increase in descent of various organs.Moreso,there is also a statistically significant increase in the levator plate angle with increasing age.
- With increasing parity there is an increase in mean values of levator hiatus width at rest and straining and increase in descent at straining.Also there is increase in levator plate angle with increasing parity though not statistically significant.

Few significant values that are to be noted from the above statistical analysis are tabulated below.

Description	Values
Mean levator hiatus width at rest when the patient shows no clinical evidence of prolapse	5.09 cms
Mean width of the hiatus at rest when there is clinically *I st degree of prolapse*	5.28 cms
Mean width of the hiatus at rest when there is clinically *II nd degree of prolapse*	5.41 cms
Mean width of the hiatus at rest when there is clinically *III rd degree of prolapse*	9.36 cms
The mean levator hiatus width at straining when the patient shows no evidence of clinical prolapse	5.771 cms
The mean width of the hiatus at straining when there is clinically I st degree of prolapse	6.318 cms
The mean width of the hiatus at straining when there is clinically II nd degree of prolapse	7.486 cms
The mean width of the hiatus at straining when there is clinically III rd degree of prolapse	9.973 cms
The average descent of pelvic organs at rest in cms in I degree prolapse	2.218 cms
The average descent of pelvic organs at rest in cms in II clinical degree prolapse	2.476 cms
The average descent of pelvic organs at rest in cms in III clinical degree prolapse	4.690 cms
The average descent of pelvic organs at straining in cms in I clinical degree prolapse	3.835 cms
The average descent of pelvic organs at straining in cms in II clinical degree prolapse	5.834 cms

The average descent of pelvic organs at straining in cms in III clinical degree prolapse	7.807 cms
The mean levator plate angle values in women without clinical evidence of prolapse	46.971 Degrees
The mean levator plate angle values in women with clinical first degree of prolapse	47.671 degrees
The mean levator plate angle values in women with clinical second degree of prolapse	50.210 degrees
The mean levator plate angle values in women with clinical third degree of prolapse	56.497 degrees

Comparative study with reference to previous studies on this topic

- In open journal of obstetrics and gynaecology, **Fernando g. de almeida, Larissa v. Rodríguez, Rhlomo raz** et al observed pelvic floor abnormalities in 46 patients which did not show any abnormalities on the static images the finding of which is similar to this study.
- **Mohamed N. El-Gharib** et al found that there was great association between parity status and the high incidence of pelvic floor dysfunction as patients of pelvic floor dysfunction in their study were found in patients with more than two normal vaginal deliveries. In this study, maximum incidence of pelvic floor dysfunctions are seen in patients with 3 vaginal deliveries. Higher the parity, higher the degree of prolapse.

- **Summers A** et al measured levator plate angle in women with normal support is 44.3 degrees. During Valsalva, women with prolapse have a modest (9.1 degrees) though statistically greater levator plate angle compared to controls. In this study also there is a statistically significant increase in levator plate angle in various degrees of prolapse.

- Though many studies have been conducted in this aspect, studies in south Indian population with respect to anatomic changes were very few. Thus this study has attempted to do this study on south Indian population.

CONCLUSION

Thus it is evident that MRI should be considered as a pretreatment planning tool when the physical findings are equivocal. MRI is not indicated for all patients with pelvic floor dysfunctions. Preferably MRI to be done for patients with pelvic floor dysfunctions who have equivocal or insignificant clinical findings, the cut off value above which a patient will have clinical prolapse having been calculated, early diagnosis can be made based on the anatomic changes and conservative management in terms of pelvic floor excercises may be considered to prevent greater degrees of prolapse and henceforth its surgical management.,MRI has proved to be superior and significant for differentiating high rectoceles and enteroceles and also for typing cystoceles. Rest of the changes do not show statistically significant difference from clinical examination.MRI has helped in improving the knowledge about regional normal anatomy. Thus it does have a role in preoperative planning to do site specific repairs and thus prevent recurrence.

MRI also helps in a universal classification(quantitative) with little inter observer variations as the case with existing classification methods and it is superior to fluoroscopy in terms of its non invasiveness,no

ionization and the ability to do thorough evaluation of pelvic organs dynamically in no time based on its high quality soft tissue imaging. The pelvic floor excercises do not seem to cause a statistically significant reduction in levator hiatus width but they have caused a significant decrease in descent of the organ(measured in terms of M line). Few of the patients who did not show any abnormality in static images showed changes in straining thus the benefit of dynamic MRI.

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ABBREVIATIONS USED

AUC	-	Area Under Curve
ATFP	-	Arcus tendineus Fascia Pelvis
CE	-	Clinical Examination
Cysto	-	Cystocele
DOP	-	Degree of prolapse
Entero	-	Enterocele
PCL	-	Pubo coccygeal line
Recto	-	Rectocele
ROC	-	Receiver Operating Characteristic curve
VCUG	-	Voiding Cystourethrogram

PROFORMA

NAME

AGE

ADDRESS

OP NO

DATE OF VISIT

HISTORY OF PRESENTING COMPLAINTS

DURATION

ASSOCIATED SYMPTOMS

OBSTETRIC HISTORY

OTHER MEDICAL ILLNESS

HISTORY OF RECENT SURGERIES/RADIATION EXPOSURE

GENERAL EXAMINATION

VITALS

SYSTEMIC EXAMINATION

CARDIOVASCULAR SYSTEM

RESPIRATORY SYSTEM

CENTRAL NERVOUS SYSTEM

ABDOMINAL EXAMINATION

LOCAL EXAMINATION

SPECULUM EXAMINATION

PELVIC EXAMINATION

BASIC INVESTIGATIONS(COMPLETE BLOOD COUNT,RENAL FUNCTION TESTS,URINE ROUTINE)

T2MRI OF PELVIC FLOOR

- H LINE,M LINE,ANGLE OF THE LEVATOR PLATE
- GRADE AND TYPE OF CYSTOCELE
- GRADE OF RECTOCELE IF PRESENT
- ENTEROCELE

SIGNATURE OF THE INVESTIGATOR:

SIGNATURE OF THE GUIDE:

Master chart has been enclosed in separate pdf file .

சுய ஒப்புதல் படிவம்

ஆய்வு செய்யப்படும் தலைப்பு : Prospective observational study to evaluate the role of MRI in diagnosis and management of pelvic floor dysfunctions.

Department of Obstetrics and Gynaecology, KMCH

பங்கு பெறுபவரின் பெயர் :

பங்கு பெறுபவரின் வயது : **பங்கு பெறுபவரின் எண் :**

மேலே குறிப்பிட்டுள்ள மருத்துவ ஆய்வின் விவரங்கள் எனக்கு விளக்கப்பட்டது. நான் இவ்வாய்வில் தன்னிச்சையாக பங்கேற்கிறேன்.எந்த காரணத்தினாலோ எந்த சட்ட சிக்கலுக்கும் உட்படாமல் நான் இவ்வாய்வில் இருந்து விலகிக் கொள்ளல்லாம் என்றும் அறிந்து கொண்டேன்.

இந்த ஆய்வு சம்பந்தமாகவோ, இதை சார்ந்து மேலும் ஆய்வு மேற்கொள்ளும் போதும் இந்த ஆய்வில் பங்குபெறும் மருத்துவர் என்னுடைய மருத்துவ அறிக்கைகளை பார்ப்பதற்கு என் அனுமதி தேவையில்லை என அறிந்து கொள்கிறேன். இந்த ஆய்வின் மூலம் கிடைக்கும் தகவலையோ, முடிவையோ பயன்படுத்திக் கொள்ள மறுக்கமாட்டேன்.

இந்த ஆய்வில் பங்கு கொள்ள ஒப்புக் கொள்கிறேன். இந்த ஆய்வை மேற்கொள்ளும் மருத்துவ அணிக்கு உண்மையுடன் இருப்பேன் என்றும் உறுதியளிக்கிறேன்.

பங்கேற்பவரின் கையொப்பம்

இடம் :

தேதி :

பங்கேற்பவரின் பெயர் மற்றும் விலாசம் :

சாட்சியாளரின் கையொப்பம்

இடம் :

தேதி :

ஆய்வாளரின் கையொப்பம் :

இடம் : தேதி :

INSTITUTIONAL ETHICAL COMMITTEE
GOVT.KILPAUK MEDICAL COLLEGE,
CHENNAI-10
Ref.No. 18520/ME-1/Ethics/2013 Dt:05.12.2013
CERTIFICATE OF APPROVAL

The Institutional Ethical Committee of Govt. Kilpauk Medical College, Chennai reviewed and discussed the application for approval "A Study on prospective observation study to evaluate the role of MRI in diagnosis and management of pelvic floor dysfunctions" – For Project Work Submitted by

Dr.Poornima Shankar,MS (O&G), PG Student.

The Proposal is APPROVED.

The Institutional Ethical Committee expects to be informed about the progress of the study any Adverse Drug Reaction Occurring in the Course of the study any change in the protocol and patient information /informed consent and asks to be provided a copy of the final report.

GOVT. KILPAUK MEDICAL COLLEGE
28 JAN 2014
Kilpauk, Chennai-10.

28/1/14

CHAIRMAN,
Ethical Committee
Govt.Kilpauk Medical College,
Chennai